AUSTRALIA AND NEW ZEALAND

FIG. 1. CAPTAIN JAMES COOK

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AUSTRALIA AND NEW ZEALAND

WITH PACIFIC ISLANDS AND ANTARCTICA

BY

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WITH MANY ILLUSTRATIONS MAPS AND DIAGRAMS

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PREFACE

THIS book aims at providing an account of the geography of Australia, New Zealand, Oceania, and Antarctica that will meet the needs of those who are studying the subject beyond the stage represented by Matriculation. It is hoped that it may prove useful not only to university students of geography, but to many who for other reasons are interested in a region in which British Imperial interests predominate.

As with the book on Africa in this series, the economic aspect has received greatest attention. Nevertheless, the attempt has been made to provide a comprehensive study dealing adequately with the physical and historical background of the development of Australia and New Zealand, as well as with the political and social conditions prevailing in the Pacific islands. The statistics which have been included are intended to illustrate in a concrete manner the basis of the geographical discussion and to provide data upon which comparisons may be made. In the method of treatment adopted a certain amount of repetition was found to be inevitable.

The author is indebted to his wife for much help in the preparation of the book, and has received many valuable suggestions from the Editor, who has, moreover, contributed an authoritative chapter on Antarctica. The *Official Yearbook of the Commonwealth of Australia*, which has reached the twenty-third year of publication, has been freely used; it contains special articles and comprehensive statistics of the greatest value. The year-books published by the Governments of New Zealand, New South Wales, and Victoria have also been consulted, as well as numerous other official publications. Reference must also be made to the Peace Handbook *Pacific Islands* and to Colonial Office reports on various island groups, while use has been made of the *Historical*

Geography of Australasia, by J. D. Rogers, of the numerous writings of Professor Griffith Taylor, of the *Intermediate Geography Text Book*, by A. V. G. James (Melbourne), and of the *Illustrated Australian Encyclopædia*, by A. W. Jose and H. J. Carter (Melbourne). Other acknowledgments have been made in the text.

The author is grateful to Mr E. R. Garnsey, who kindly read the proofs of those parts which deal with Australia, to other officials of Australia House, and to the representatives in London of New Zealand and of the various Australian states, for much courteous assistance and for permission to make use of many illustrations, diagrams, and maps. He further desires to express his indebtedness to his colleague Mr E. J. Hemmings and to the officials of the Library and of the Statistical Department of the Imperial Institute. He can scarcely hope that the text is completely free from errors; the responsibility for any that may have inadvertently crept in, as well as for any opinions expressed, rests with him.

L. S. SUGGATE

June 1931

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CHAPTER I

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General Considerations

The wide area covered by this volume includes Australia, New Zealand, the islands of the East Indian or Malay Archipelago which are not specifically Asiatic, Oceania, and the Antarctic.

The line of division between the geographically Australian and Asiatic islands is commonly taken to be that drawn in the middle of last century by Alfred Russell Wallace between Bali and Lombok, through the Macassar Strait, and south of the Philippine Islands. 'Wallace's line' was based upon his observations of East Indian fauna and flora. He noted that Australian mammals are almost all of the marsupial type, and that birds of Paradise, lyre-birds, and cassowaries are confined to the Australian area, in which, too, snakes and lizards are of peculiar types. In the western half of the Malay Archipelago, however, he found a special development of the animal life typical of Siam and Burma, and including in Borneo and Java tigers, elephants, tapirs, and wild cattle. Similarly, the flora of the western islands has distinct affinities with that of the neighbouring Asiatic mainland, merging eastward into the characteristically Australian type. From the resemblances of the fauna of New Guinea, the Moluccas, and Australia to the European fauna of Secondary age it is inferred that Australia was isolated from Asia probably in Jurassic times, though the islands mentioned were doubtless attached to Australia until a considerably later time.

Although the line of division is to-day criticized as being biologically less definite than Wallace concluded it to be, it receives confirmation from a study of the submarine contours of the region. Thus the 100-fathom line shows Borneo, Bali, Java, and Sumatra to be situated on the Asiatic continental shelf, and submarine links that rarely exceed 300 feet in depth connect them, while islands to the east, although with the exception of New Guinea not upon the Australian continental shelf, are beyond the 100-fathom line that encloses those geographically belonging to Asia.

Oceania is a term loosely applied to the numerous islands of the Pacific Ocean; those south of the equator are sometimes referred to as the South Sea Islands. The islands are grouped into three divisions: *Melanesia*, lying east of New Guinea and including the New Hebrides, New Caledonia, and Fiji; *Micronesia*, covering the islands lying north of New Guinea and Melanesia; and *Polynesia*, comprising the groups lying to the east, in which the principal ones are Hawaii, the Society Islands, and Samoa.

It is plain that the scattered nature of the area covered by this volume involves wide differences in physical conditions and a variety of racial and settlement problems, although it is worthy of note that the political affiliations are mainly British. Despite the fact that the northern and western parts of Australia were the first to be touched by Europeans, the important settlement on that continent is chiefly on the Pacific margins, and as the islands essentially belong to the Pacific Ocean it is advisable, before proceeding to sectional studies, to discuss the general geography of the Pacific Ocean and to outline its discovery and importance in the modern world.

Physical Geography

The southern boundary of the Pacific Ocean is often taken to be 40° S., but beyond this, and almost devoid of islands, it stretches as the Southern Ocean to the ice-bound shores of the Antarctic continent between the Ross Sea and Graham Land. The Pacific is roughly circular in shape; the

shallow Bering Strait—about thirty-six miles wide at the narrowest and barely 300 feet deep—is a barrier to any but surface currents of cold water from the Arctic basin; the greatest width, some 10,000 miles, is in equatorial latitudes. Its area exceeds that of the land-surface of the globe, and comprises nearly half the total water-surface. Its antipodes include the whole of Africa and Europe and more than half Asia. The land area draining to the Pacific Ocean is only about a quarter of that draining to the Atlantic, despite the fact that the water-surface of the former is nearly twice that of the latter. This is related to the physical character of the Pacific coasts.

Coasts. Professor Suess distinguished two main types of coastal structures, which he called respectively the Atlantic and the Pacific types. In the Atlantic Ocean he noted the parallel character of the opposite coasts, the absence of young fold-mountains, the structural resemblance noticeable in certain latitudes, as, for example, in the Brazilian and African plateaus, the variety of coastal features—here plain land, elsewhere old broken mountain lines or fractured table-lands- and the irregular arrangement of the few oceanic islands.

The Pacific Ocean presents quite different coastal features. Its eastern margins are marked by the great cordilleran systems of North America and South America, so that, except in Central America, mountain chains run parallel to the shore and rise steeply from it. On the western side the formation is different: the high central plateau of Asia sinks down by steps to the Pacific, with almost enclosed seas bordered by island festoons which mark an earlier coastline. Again, the Eastern Highlands of Australia are faulted down to the Pacific Ocean, a festoon of islands from New Guinea and New Caledonia forming the eastern margin of the Coral Sea. It is notable that New Caledonia is non-volcanic, and seems to be slowly subsiding; geologically it has affinities with New Zealand.

It is further to be observed that opposite coasts in the Pacific show no structural resemblances, while the linear arrangement of islands noticeable in the festoons already

referred to is also to be seen in the island chains of the mid-Pacific. Another significant feature is the 'volcanic girdle' of the Pacific Ocean. Active vulcanism is found from Kamchatka through the Japanese islands to the North Island of New Zealand, in Central America and the northern half of the Andean chain, as well as in the Hawaiian Islands, while seismic disturbances are common to most of the bordering lands.

The Ocean Floor. *The Pacific is noteworthy for its great* average depth. Sir John Murray estimates that 72 per cent. of the area exceeds 2000 fathoms, 7 per cent. being deeper than 3000 fathoms. The eastern half is notable not only for its relative lack of islands, but also for the relative uniformity of the floor, while many of the trenches and deeps are situated near to the chains of islands in the western half of the ocean. Broadly speaking, the floor consists of gently undulating plains varied, chiefly in the western half, by submarine ridges, on which arise oceanic islands, and by occasional broad basins and long trenches. The principal submarine ridges are (1) the roughly west-to-east ridge bearing the Hawaiian Islands in the neighbourhood of the Tropic of Cancer, (2) the roughly west-to-east ridge by the southern tropic bearing the Tuamotu (Paumotu or Low) Archipelago and the Society Islands, with a parallel ridge to the south marked by the Cook Islands and a rise to the north indicated by the Marquesas Islands, (3) a ridge stretching northward from New Zealand, marked by the Fiji and Tonga groups, then bearing north-westward and westward, with the Marshall and Caroline Islands, (4) another ridge curving north-westward from New Zealand, indicated by New Caledonia, the New Hebrides, the Solomon Islands, the Bismarck Archipelago, and New Guinea, (5) a ridge stretching south from Japan, with the Mariana or Ladrone Archipelago. Submarine ridges may also be followed between Celebes and the Philippines and from Northern Australia through Timor and Flores to Java.

Broad, deep basins (over 3000 fathoms in depth and classified by Sir John Murray as 'deeps') are found north and west of the Hawaiian Islands and notably to the east of the

Japanese and Kurile Islands, the Ladrone Archipelago, the Philippines, and the Tonga and Kermadec groups. Of fifty-seven known deeps in the world thirty-two are in the Pacific, and those near the island chains already mentioned show long and narrow trenches over 4000 fathoms in depth and in places showing extreme depths exceeding 5000 fathoms. It is noteworthy that only in this ocean are depths exceeding 5000 fathoms known. Among the extreme depths recorded may be mentioned 5155 fathoms near the Tonga Islands, 5269 fathoms in the Ladrone Deep, and 5348 fathoms (32,088 feet) in the Swire Deep, off Mindanao. This last represented the greatest known depth till the German cruiser *Emden* in 1927 probed somewhat deeper in the same deep.

The almost enclosed seas of the Western Pacific are relatively deep basins due to subsidence. Such are the Celebes Sea, the Banda Sea, and the Coral Sea, the last being over 2500 fathoms deep and cut off from the main ocean by a barrier the deepest part of which is 1300 fathoms. They are of the same origin as the China Sea, the Yellow Sea, and others farther north.

Deposits of the Ocean Floor. Terrigenous deposits due to land waste are those lying adjacent to the land, and are seldom met with beyond 300 miles from the shore. These are usually in the form of sands or muds, blue, red, or green in colour, derived from the wearing of the land-surface, or they may be volcanic or coral muds. The deposits in the open ocean far from land are termed pelagic. The pelagic deposits of the Pacific Ocean present several interesting features, which mainly arise from its enormous area, its great depth, and the vulcanism that characterizes it.

Swarming in the surface waters are minute protozoa, globigerines, and radiolarians, the tests or skeletons of which are respectively calcareous or siliceous, together with molluscs and other pelagic fauna. Calcareous organisms are most abundant in tropical and temperate seas, but as the minute skeletons fall through great depths of water they tend to dissolve. Hence, owing to the great depth of the

Pacific Ocean, the deposits of globigerine ooze and pteropod ooze (the latter a variety of the former, but with a greater abundance of mollusc shells fallen from the surface) are relatively scanty. Globigerine ooze is found chiefly in the south-east quadrant of the Pacific and in a belt between New Guinea and New Zealand and pteropod ooze particularly in the neighbourhood of the Fiji and Society groups; the latter is commonly found at a less depth than the former, and is common in the neighbourhood of coral reefs.

Siliceous organisms prefer fresher and colder seas, and as the skeletons are insoluble there is nothing to hinder the formation of a deposit. Thus there are areas of diatom ooze in the Far North and Far South in which rock fragments derived from land ice are common. The diatoms are microscopic plants with siliceous tests. Another variety of siliceous organism is the radiolarian. Radiolarian ooze—which is unknown in the Atlantic Ocean—covers a considerable area in the Pacific, chiefly round the Phœnix Islands and about latitude 10° N. in the eastern half. It is really a variety of red clay containing an appreciable proportion of radiolarian skeletons.

Red clay is perhaps the most interesting of the deposits. It consists of volcanic particles more or less decomposed, and is rich in hydrated silicate of aluminium and iron. It contains no calcareous remains, but in less deep water in the warmer latitudes it merges into globigerine or radiolarian ooze and in the North Pacific into diatom ooze. Pumice in all stages of decomposition characterizes it, and manganese nodules, sharks' teeth, and the ear-bones of whales are often met with, with occasional meteoric fragments. It varies from dark red to chocolate brown, covers the greater part of the North Pacific, as well as large areas in the south, and is evidently derived from the materials of volcanic eruptions which have sunk to the bottom of the deep ocean, whose great depth or high surface temperature prevents the deposit of organic remains. Sometimes this deposit of red clay is found to overlie radiolarian ooze, from which fact subsidence is inferred.

Currents, Surface Temperatures, and Salinity. The great size of the Pacific Ocean, together with its shape, permits the development of a relatively simple circulation. As the Doldrums belt of low pressure lies generally north of the equator, it is not surprising that the west-moving currents set up by the trade winds are not symmetrically arranged about that latitude. The South Equatorial Current lies just south of the equator, with the North Equatorial Current about 10° N., the east-moving counter-current in between also lying north of the equator. The Equatorial Currents take a great deal of warm water toward the East Indies, where the islands break it up into various streams, the most important of which are (1) that running northward past the Philippines and becoming the Kuro Siwo off South Japan, beyond which the westerly winds drift the warm water toward North America, (2) the East Australian Current, which carries warm water southward into the Southern Ocean. Other but less definite currents turn off southward from the South Equatorial Current in mid-ocean, and the circulation of the South Pacific is completed by the West Wind Drift, which runs eastward south of 40° S., turns northward along the west coast of South America, to merge into the cold Peruvian or Humboldt Current, that carries cold water into the eastern part of the South Equatorial Current.

As a result of the flow of the Equatorial Currents it is not surprising that an enormous quantity of very warm surface-water is massed into the West Pacific between the tropics. Mean annual isotherms of the surface-water show that the East Indies and all the important groups in the Western Pacific, with the exception of the Marquesas, the Tuamotu, Society, and New Caledonian Islands, are surrounded by water at a temperature of over 80° F. Along the equator in the Eastern Pacific the surface temperatures are between 75° F. and 80° F., as the Humboldt Current brings a contribution of cool water which notably affects the arrangement of the isotherms along the western seaboard of South America. South of the broad belt of very warm water in tropical latitudes the surface temperatures grade into the cool waters of the west wind belt the 60° F. surface annual

isotherm running from just south of Cape Howe to the middle of the North Island of New Zealand.

The annual range of surface temperature is small along the equator, and is less than 10° F. over the greater part of the area of very warm water referred to above. It increases markedly off the south-eastern shores of Australia and round New Zealand, in both regions exceeding 20° F. The annual range of surface temperature is an important factor in determining the distribution of organisms and especially of reef-building corals.

The warm water of tropical latitudes is a relatively thin film. In the open ocean the water temperature declines very rapidly at first, then gradually to temperatures of about 35° F., reached generally at rather more than 2000 fathoms, bottom temperatures in the great deeps seldom falling below this figure, though toward the Antarctic continent lower bottom temperatures are recorded. In the almost enclosed seas, however, temperatures decline only to the temperature of the open ocean at the level of the ridge which separates them. Thus the Coral Sea, a basin reaching 2500 fathoms, has a uniform temperature of 36° F. below 1300 fathoms, which is the level of the barrier cutting it off from the Pacific Ocean. Similarly, the Celebes Sea has a uniform temperature of 39° F. below 500 fathoms.

The degree of salinity at the surface principally depends upon the factors of evaporation and precipitation, but it is also affected by the oceanic circulation and by the upwelling of cold and less saline water as exemplified off the west side of South America. The average for the ocean is 35 parts per 1000 (a specific gravity of 1·06 at 60° F.); in the Doldrums belt, and especially in the western part of the East Indian archipelago, where the rainfall is heavy, the salinity falls below the average, as it does also in the belt of the westerly winds. In the trade wind belts, particularly in the latitudes of the south-east trades and in the horse latitudes, the salinity is above the average, owing to the considerable evaporation, a large area in this belt rising to a salinity above 36·5.

Plant and Animal Life

Depth, sunlight, temperature, and currents all affect the distribution of life in the waters of the ocean. Broadly speaking, the superficial layer affected by sunlight (the photic zone) contains vast quantities of unicellular algæ, but the deeper waters contain no plant life. The living plants near the surface provide food for herbivorous creatures, while the dead remains of algæ sink down to yield food for the animals that live at the bottom of the sea. Algæ are found at greater depths in the warmer latitudes, while siliceous diatoms frequent less saline waters. The larger fauna includes such warm-blooded animals as whales, porpoises, dolphins, and seals, and fishes and invertebrates of all kinds, while the microscopic animal life includes such forms as globigerines and radiolarians. In the deeper waters the forms of animal life are adapted to conditions of low temperature, great pressure, and absence of light, while in the tropical zone it is noteworthy that while genera and species are many, the individuals are relatively few. There is a great variety of animal life in the shallow waters of the tropical regions, especially near the land and in the neighbourhood of coral reefs, where crustaceans and other creatures that require lime are very abundant.

Coral. The activities of coral polyps have special importance in the Pacific Ocean. Coral is composed of the hard skeletons of certain marine organisms allied to sea-anemones, and consists of lime. The reef-building corals of the more massive kinds flourish in great colonies, principally in clear, shallow, tropical waters the temperature of which is well above 68° F. Remains of calcareous algæ, foraminifers, and other organisms, especially molluscs, are often found in coral masses because of the profusion of other life that is met with by coral reefs. Reefs have a variable distribution; thus while there are extensive reefs round the Caroline, Fiji, and Samoan groups, they are almost absent round the Mariana and the Eastern Hawaiian Islands. Coral reefs are usually classified as fringing reefs, barrier reefs, or atolls.

Fringing reefs are coral platforms relatively close to the

shore, with an outer edge sloping steeply into the shallow water. They are often covered except at low tide, and are broken by channels opposite the streams from the land; the active growth is on the seaward edge, because of the unfavourable conditions on the inner side—fresh water, land waste, and lack of ocean surface organisms.

Barrier reefs are larger, and farther from the land. A relatively deep channel separates a barrier reef from the

FIG. 2. A SMALL ATOLL IN HILO BAY, HAWAII
Photo E.N.A.

mainland. A steep outer edge, often descending to great depths, is found. The reef may form a long, low strip covered with vegetation; it is frequently fringed with islets formed of dead coral and sand piled on the outer edge as a result of wave action.

Atolls are islands composed solely of coral: no other rock occurs. Annular in shape, they vary in diameter from a few hundred yards to many miles. Some of the smaller ones present a complete ring, water entering and leaving with the tide through the coral or by a single channel. Others are broken into many small islands arranged approximately in a ring. The lagoon is generally very shallow, but the steep outer edge descends to considerable depths. The contrast

between the outer beach, on which the surf breaks, with the calm inner beach is remarkable. Coral reefs seldom rise much above sea-level.

Islands

Many of the larger islands of the Western Pacific contain evidence of an earlier connexion with Asia or Australia. Thus in New Britain rocks of Primary age are found, while New Caledonia contains Archæan, Triassic, and Cretaceous formations. But the scattered groups are, broadly speaking, of either volcanic or coral origin, which gives rise to the characteristic division into 'high' and 'low' islands. Volcanic islands are lofty in proportion to their size, and owing to their relatively large area and fertility are of far greater importance. Mauna Kea, in Hawaii, reaches a height of nearly 14,000 feet, but this elevation is very exceptional. Tahiti shows a maximum elevation of nearly 8000 feet, while heights of over 4000 feet are found in the Fiji group. Volcanic activity survives in the Hawaii, New Hebrides, Solomon, Bismarck, and Tonga groups and in the North Island of New Zealand. Coral reefs frequently fringe the volcanic islands.

The low coral islands are very numerous. They are commonly of the atoll type, low and flat, seldom exceeding 20 feet in elevation. Boulders of broken coral are flung upon the outer beach, while the reef flat, if broad, is covered with coral sand. Percolating water assists in consolidating the whole mass. In some cases elevation has occurred, as in the Loyalty Islands, where two or even three former coral reefs now appear as low cliffs; such a coral island may rise to a considerable height. The Tuamotu Archipelago is the most extensive of the coral groups.

Origin of the Atoll. The atoll, with its isolated position, its peaceful lagoon, and the great depth from which it rises, has necessarily attracted considerable scientific attention. Charles Darwin in 1842 developed the theory of subsidence. He assumed that all reefs began as fringing reefs, and held that if the sea-floor should subside (or, alternatively, the level

of the sea rise) the corals would grow upward again. As the outer edge of the reef grows rapidly, keeping pace with the subsidence, a lagoon would be formed between it and the land, and the reef would become a barrier reef, and with further subsidence, if the reef has originally been formed round a small island—*e.g.*, a volcanic island—the submergence of this would leave only the ring of reef, descending on the outer side to great depth.

This view has been widely criticized, especially by certain American observers and by Sir John Murray. Sir John Murray supported an entirely different hypothesis. He claimed that atolls take their rise from submarine elevations that rise sufficiently near the surface for building corals to work or upon elevations the height of which is sufficiently increased by pelagic deposits. As the outer corals of such colonies grow most freely, they reach the surface first and form a ring. This view is supported by the occurrence of atolls where there is no evidence of subsidence and by the occurrence of examples of coral islands resting on marine muds with volcanic rock below; nevertheless, it does not explain very satisfactorily the shallow lagoon nor the descent into deep water on the outer edge.

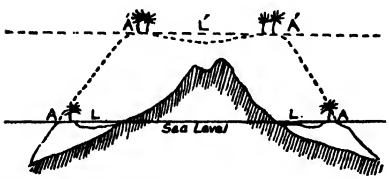

FIG. 3. DIAGRAM ILLUSTRATING THE FORMATION OF AN ATOLL

AA, fringing reef formed when volcano rises well above the surface, enclosing lagoon, *LL*. Submergence with coral growth proceeding concurrently would lead to the development of a barrier reef and ultimately to an atoll of annular shape, *A'A'*, enclosing lagoon, *L'*.

The glacial control theory associated with the name of R. A. Daly presents another view. It assumes that the level of the ocean has varied, especially as the result of the locking up of water on the land during the Ice Age. The lower levels of coral may then have been formed, to be later built up as the water rose.

Present-day opinion inclines to the view that coral islands show several modes of formation, and that Darwin's explanation combined with Daly's is satisfactory for many, if not for most. This is supported by the borings made in

the Funafuti atoll (in the Ellice group) in 1896, when coral formation was found to a depth of more than 1100 feet, far below the depth at which the coral polyp can live. Finally, a recent study by Professor W. M. Davis gives strong support to these explanations.[1]

General Climatic Conditions. The Doldrum belt is bordered by the belts of the north-east and south-east trade winds. Most of the islands lie within these belts. In the southern half of the Pacific (neglecting South America) the important areas outside the southern tropic are the greater part of Australia, Tasmania, and the islands of New Zealand. These areas are in temperate latitudes, and Tasmania and the South Island of New Zealand are in the belt of the westerly winds, but as the extreme south of New Zealand is about 47° S. the latitudes of cold winters at sea-level are not reached.

It follows that the scattered groups of islands within the tropics, as well as the bordering mainland, have uniformly high temperatures, though not the excessive heat of continental regions in similar latitudes. In the inter-tropical groups the annual range varies from 1° F. to 9° F., and even the extreme south of New Zealand shows an annual range of only 16° F. Moreover, the relative humidity is generally high, owing to oceanic influence.

The Doldrum belt of equatorial calms is broader than in the Atlantic, and the trade winds are neither so strong nor so persistent. Thus the Fiji, Samoan, and Society groups have a season when the south-east trades alternate with north-easterly and northerly winds and with calms. The Marquesas, on the other hand, receive the south-east trade wind constantly.

In the Western Pacific meteorological conditions are modified as a result of the Asiatic and Australian monsoons, so that the south-east trade wind is only fully developed off the north-eastern coast of Australia in the southern winter.

In general the precipitation is considerable. The monsoon effects on the western margins of the inter-tropical latitudes

[1] *The Coral Reef Problem*, by W. M. Davis (1928).

are accompanied by a high relative humidity. The islands, particularly in the west, show no well-marked season of rain, though the southern summer yields the greater rainfall even as far north as Hawaii.

In the trade wind belt the heaviest rain is normally on the windward side of the islands. The rainfall is often variable and frequently violent, and destructive cyclonic storms are common. These violent circular storms occur chiefly in summer and autumn, and are generally experienced in the trade wind belt; they are frequently severe in Fiji, the New Hebrides, and New Caledonia. Their tracks are from east to west, curving southward as the Queensland coast is approached.

Vegetation and Fauna of the Islands. The rich vegetation of the lofty volcanic islands, especially on the windward flank, contrasts with the poor vegetation of the low coral islands, which are frequently covered with porous, sandy soil and suffer from drought. Plants usually show wide distributions owing to propagation by winds, currents, and migratory birds. Indigenous fruits are few, most of the cultivated ones having been introduced. The banana has great importance, as also have roots such as taro, yam, and arrowroot, while among the characteristic trees—coconut, breadfruit, pandanus, and mangrove—the first has a leading place in economic life, the breadfruit-tree and pandanus providing other important foods.

The islands are very poor in mammals, bats and introduced rats being the most typical specimens, while doves and pigeons are characteristic birds. Insect life is poor except in Melanesia and Fiji. The atolls have only a scanty fauna —generally including a few birds, lizards, and insects. On the other hand, the sea is rich in animal life; the shallow lagoons of the atolls yield considerable quantities of edible fish, and frequently various shells valuable for mother-of-pearl and pearls. The presence of numerous whales, especially the sperm whale, led to considerable whaling activity in the nineteenth century.

THE PACIFIC OCEAN

Discovery

The voyage of Columbus to the West Indies in 1492 led to the famous Bull of Pope Alexander VI and the subsequent Treaty of Tordesillas in 1494, which assigned all lands west of a line of longitude running 370 leagues west of the Azores to the crown of Castile. The Portuguese accordingly worked eastward into the unknown parts of the world, and Vasco da Gama reached India (1498), while other expeditions, in which Magellan (Fernão de Magalhães) participated, reached Malacca and the Moluccas. Spain worked westward, and Vasco Nuñez de Balboa saw the Pacific from "a peak in Darien" in 1513. In 1519 Magellan, now in the service of Spain, commanded the little fleet of five small vessels that set out on the first voyage round the world. El Mar Pacifico was entered from the Magellan Strait in November 1520, and a remarkably calm voyage across the ocean, during which only two desert islands were sighted, brought them to the Ladrone Islands. Magellan himself perished in a tribal squabble in the Philippines, and one ship only returned to Spain in 1522.

But the approach to the Pacific and more particularly to the chief island groups was facilitated from the west by the interest that the Portuguese were taking in the East Indies *via* the Cape route. Thus Magellan's expedition on reaching the Moluccas in 1521 found the Portuguese already there, while another Spanish expedition, which coasted along the north of New Guinea in 1529, had been forestalled two years previously by the Portuguese, who by this time had also reached the Caroline Islands. The Portuguese possibly acquired some knowledge of the north coast of Australia, for a map, the "Dauphin Map," of about 1530, shows Java separated by a narrow strait from a large land-mass called "Jave la Grande," stretching vaguely southward, and no doubt to be identified with Terra Australis, a traditional southern continent belief in which had survived from classical times.

Spaniards sailing west from Mexico discovered the Hawaiian group in 1555, and made settlements some ten years later in the Philippines and the Ladrones. Intercourse

across the Pacific between their new possessions in Central America and South-east Asia no doubt went on, but did not *touch the main Pacific groups, which lie to the south.* However, the Solomon Islands were explored in 1567, and the Marquesas and Santa Cruz reached in 1595. Pedro Fernandez de Quiros had taken part in the last expedition,

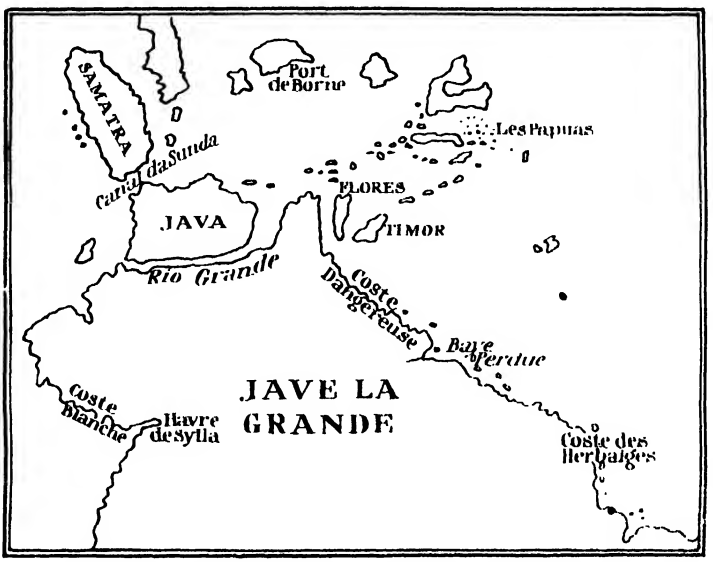

FIG. 4. FROM THE "DAUPHIN MAP," OF ABOUT 1530

The "Dauphin Map" is believed to be based upon a Portuguese original. It will be noticed that the north east coast of "Jave la Grande" shows striking resemblances to the north east coast of Australia.

and in the years 1605–7 he went through the Paumotu or Low Archipelago and the Society Islands, and reached the main island of the New Hebrides, Espiritu Santo, convinced that he had at last discovered the traditional southern continent. One of his lieutenants, Luis Vaez de Torres, however, sailed round this island, and, working westward, reached the Philippines *via* the strait that now bears his name. Torres' voyage and his strait were, however, forgotten, and even until the middle of the eighteenth century Espiritu Santo was believed to be part of the southern continent.

Meanwhile the Dutch rivalry of the Portuguese had begun to make its mark. In 1606 a small vessel, the *Duyfhen*, left Java to explore the coast of New Guinea, passed the Torres Strait without noticing it, and coasted along the west side of Cape York Peninsula as far as Cape Keerweer. In 1616 Dirk Hartog, keeping a too easterly course across the Indian Ocean on his way to Batavia, touched Australia at Shark Bay.[1] Houtman's Rocks (west of Geraldton), Arnhem Land, and Cape Leeuwin commemorate other Dutch discoveries of this period, during which Pieter Nuyts touched the coast of the Great Australian Bight, so that by the time Abel Tasman sailed round the south of Tasmania (which he called Van Diemen's Land) in 1642 the coast of Australia had been reached at various points along the north, west, and south. As Tasman's voyage took him beyond Tasmania to New Zealand, the Friendly Islands, the Fiji group, and round the north coast of New Guinea to Java, he believed he had encircled the southern continent, to which the name New Holland was subsequently given.

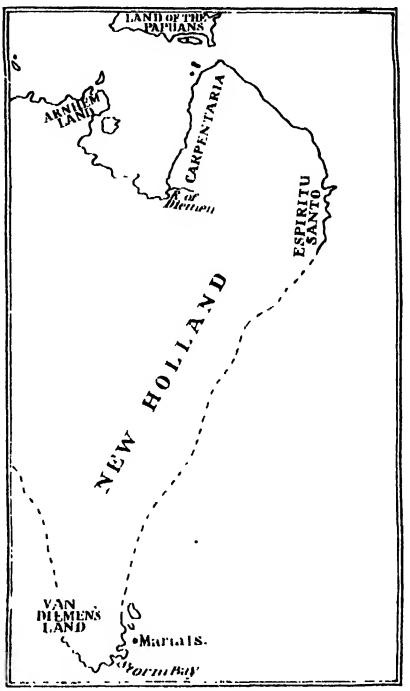

FIG. 5. FROM ROBERT DE VAUGONDY'S MAP OF NEW HOLLAND, 1756

De Qu... 1606 discovered Espiritu Santo, m... brides, and believed that it belonged ... the Ne... southern continent. This view was ... held for a long time.

But the detailed knowledge was scanty, and the east coast

[1] He left an inscribed pewter plate on a post: the plate is now preserved in the State Museum, Amsterdam.

was unknown. Moreover, the reports of the inhospitable character of the north coast and of the barrenness of the west and south coasts, confirmed by the voyages of the famous English buccaneer and explorer William Dampier in 1688 and 1699, did not encourage any serious interest in the new continent. The modern period of the opening up of the Pacific and of Australia dates from about the middle of the eighteenth century, and several nations contributed to the new knowledge. Islands—some touched during the earlier period—were discovered and rediscovered, with much confusion of nomenclature, while the true outline of the Pacific coast of Australia was brought to light, as well as the real relationship of Tasmania and New Zealand to the Australian continent.

Thus Samuel Wallis touched Tahiti and the Marianas in 1767, and Louis-Antoine de Bougainville reached the Society and Samoan groups and the Northern New Hebrides. But this period of discovery is inseparably associated with the name of Captain James Cook, although after his time mention may be made of Jean-François de la Pérouse, who reached in 1786 Easter Island (previously visited by Jacob Roggeveen in 1721), Samoa, and Tonga; of the *Bounty* mutineers, who left Tahiti in 1789 and escaped to the unknown and uninhabited Pitcairn Island; of Joseph-Antoine d'Entrecasteaux, who rediscovered Tonga in 1792; and of Russian exploration in Eastern Polynesia under Adam Ivan Krusenstein in the early years of the nineteenth century.

James Cook enters the story of the discovery of the Pacific with the commission he received from the Royal Society to observe the transit of Venus from Tahiti, in the Society Islands, in 1768. In command of the *Endeavour*, of 370 tons, he entered the Pacific *via* Cape Horn, observed the transit of Venus in June 1769 from Tahiti (lately discovered by Samuel Wallis), and sailed south-westward to New Zealand, landing at a spot he called Poverty Bay, as he was unable to obtain provisions from the hostile natives. He spent six months sailing round the islands, proving they were unrelated to a southern continent, and then worked westward from Tasman Bay (Cape Farewell), to sight the

east coast of Australia in the neighbourhood of Cape Howe. Turning northward, he entered Botany Bay, and eventually reached Cape York, charting the whole east coast. He confirmed the separation of New Guinea from Australia.

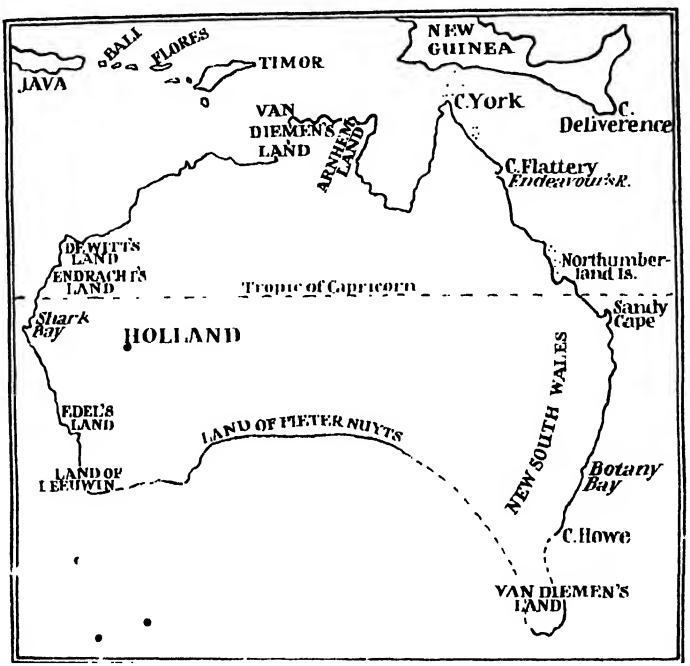

FIG. 6. AUSTRALIA AS KNOWN AFTER CAPTAIN COOK'S EXPLORATION OF THE EAST COAST

On his second voyage (1772 75), in the *Resolution*, of 400 tons, Captain Cook made several attempts to penetrate the Antarctic, exploring meanwhile the Southern Pacific and touching New Zealand, Tahiti, Easter Island, and the New Hebrides. In 1776, in the same ship, he set out to attempt to solve the problem of the North-west Passage from the Pacific. Unable to penetrate the Bering Strait, he turned south, and called at Hawaii in February 1779, where he met his death on the beach at Kealakakua Bay.

Captain Cook's work on the east coast of Australia was completed by George Bass, James Grant, and Matthew Flinders, who between 1797 and 1802 added the coast of Victoria and South Australia to the map of the continent.

Naturalists had accompanied Cook on his second voyage, but of a more important scientific character were the voyage of the *Beagle* in 1835 under Captain Fitzroy, accompanied by Charles Darwin, various American, Austrian, and Italian expeditions between 1839 and 1868, and the famous *Challenger* cruise of 1872–75, led by Sir Wyville Thomson, and followed by the American expeditions in the *Tuscarora* (1873-76) and the *Albatross* (1889–92). To the *Challenger* and to later discoveries is due the present comprehensive knowledge of the physical conditions of the Pacific.

Peoples

Leaving aside the Mongoloid Malays found in Celebes, the Moluccas, and the Sunda Islands, who live on the fringe of the area and represent a different economic type from the others, there are four existing races and one extinct race to which reference must be made.

The extinct race inhabited Tasmania, and died out well before the end of the nineteenth century. The Tasmanians were a negroid type, black and woolly-haired, allied to certain types that still survive in New Guinea, and it is conjectured that they reached Tasmania *via* the east coast of Australia at an early period. Their stone implements and general culture were of a distinctly lower type than those of the aboriginal inhabitants of Australia, who are a dark-skinned Caucasian type related to certain pre-Dravidian types still found in parts of Southern India, Ceylon, and the Malayan Archipelago. These people probably reached Australia in the north-west, and seem to have reached South-east Australia only relatively recently. They are a wavy-haired, chocolate-coloured, well-bearded race, with overhanging brows, wide nostrils, and receding forehead. Whether their primitive culture arises from their primitive origin or is an adaptation to the physical conditions of the continent is a question still

the subject of discussion. Their numbers and mode of life were adapted to a largely arid continent which contained no plants suitable for cultivation and no animals fit for domestication (except the all but wild dingo), their tools were made of wood or stone, their huts were of the simplest description, and pottery and weaving were unknown. Nevertheless, their mental ability should not be rated too low, for the children have often proved, in schools on the reserves, to show considerable ability. The Australian aboriginals have been described as "the loneliest of lonely races," for their contact with other races in the Pacific seems to have been extremely scanty.

FIG. 7. A MELANESIAN TYPE

A native of the Banks Islands, Northern New Hebrides. Compare this illustration with that on p. 10.

Photo B. N.A.

The characteristic race of Melanesia, stretching from New Guinea through the Solomons, Loyalty, New Hebrides, and Santa Cruz Islands to the Fiji group, is the negroid type often referred to as Papuan. Melanesia means 'the Islands of the Blacks.' The headquarters of this race are in New Guinea, Papuan being the Malay name for the inhabitants of this island. With many of the characteristics of the African type, the Papuan, who is the aboriginal of the area, shows admixture with Polynesian and Malay. With nose, lips, and jaw less prominent than in the negro, the Papuan commonly bears a mop of black, crisp, curly hair. Throughout the great belt of Melanesia the Papuan shows considerable variations of size and of colour, and his wide distribution is something of a

mystery, as he is by no means the most skilled sailor of the Pacific.

To the north of Melanesia is Micronesia ('Small Islands'), including the Carolines, Marianas, etc., and inhabited by a brown race showing wide variations. They are probably Malays in origin, but there has been much racial mixing; Melanesia, Polynesia, and even Japan and China have each made a contribution. Stature is often stunted, and complexions are dark, the hair black and lank. The Marshall Islanders are the most skilful navigators of the Pacific; they undertake long voyages lasting many months in great outrigger canoes and use curious charts made with sticks and shells.

FIG. 8. A POLYNESIAN TYPE

A Tahitian native, providing many physical contrasts with the Melanesian (see p. 39).

Photo E.N.A.

The Polynesians inhabit a great arc of small island groups stretching from Hawaii in the north through the scattered groups of the Central Pacific, the Samoan, Tonga, Society, and Marquesas Islands, round to New Zealand, but excluding Fiji, where, however, Papuan is mixed with Polynesian. The Polynesians are a brown-skinned Caucasian type similar in language and colour to the Malays, but racially distinct. They possibly colonized Polynesia from the Malay Archipelago in Neolithic times, and reached New Zealand only some six centuries before white people began to settle there. Generally light brown in colour and tall, they are frequently handsome, as, for example, the Samoans. Though a fine physical type, with brown or black hair and small beards, the cheerful temperament, combined with the easy life of the

islands, seems to have led to a certain deterioration. Thus the huge decked vessels capable of carrying 100 or 200 people that they used to construct are now hardly known. There is a remarkable uniformity of the Polynesian language throughout the islands, and among many interesting characteristics of the Polynesians may be mentioned their utter

Fig. 9. Monoliths of Easter Island

Statues on the slope of Rana Rayaku volcano. Note the long ears and protruding lips.

Photo E.N.A.

lack of acquaintance with metals, the absence of pottery-making, and the practice of cooking by baking in holes in the ground. They are well skilled in the use of wood and of vegetable fibres, though canoe and house-building occupations seem largely confined to certain families.

Prehistoric Remains. The occurrence of certain widely scattered remains still presents an unsolved problem. On Easter Island there are many stone platforms of immense size, together with huge stone images. There are similar remains on Pitcairn Island, in the Carolines, and in the Marianas. On Tongatabu, in the south of the Tonga group,

is a monument built of large stone blocks that could not have been obtained from the island and must therefore have been brought by sea. There is no local explanation of these remarkable works, which provide much scope for archæological speculation.

European Penetration. The Dutch and Portuguese established themselves in the eastern part of the East Indies and the Spaniards in the Philippines in the early days of their discovery, though the development was not generally of an intensive character. It is not surprising, bearing in mind the brief account of the discovery of the Pacific that has been given above, that the Pacific islands generally, as well as Australia and New Zealand, did not receive attention from Europeans until much later. The first settlement in Australia took place in 1788, when Governor Phillip, after landing at Botany Bay, established himself at Port Jackson. The great distance of the new continent from Britain, however, together with its use as a dumping-ground for convicts—not finally abandoned till 1868—tended to hinder genuine settlement, so that by 1850 the white population, mostly in the south-east, totalled only 400,000. Gold discoveries then led to a rapid increase. But already the foundation of serious political and racial problems was being laid, for as early as 1833 attempts were made to introduce Indian labour, in 1848 Chinese were imported, and later Kanakas (Pacific islanders) were brought in as labourers.

Missionaries began to take an interest in the Pacific islands before the end of the eighteenth century, one of the earliest stations being established in Tahiti, in 1797. In the early part of the nineteenth century whalers and sealers began to pursue their activities in the South Pacific, and traders and agents to deal in sandalwood, copra, trepang, pearls, and tortoiseshell. Sandalwood was first discovered in Fiji in 1804. British and United States traders mainly pursued this trade, and political complications were introduced. Some of the early settlers were deserting sailors or penal refugees from Australia. Many traders belonged to the unscrupulous class of 'beachcombers,' and the kidnapping of natives for labour in Eastern Australia and South

America which was rife in the middle of the century sometimes led to reprisals.

The French, as has been pointed out, were also interested in the Pacific. La Pérouse visited Botany Bay shortly after the first British settlement at Port Jackson. The British Government had repudiated Captain Cook's action in taking possession of New Zealand in 1796, and these islands became the unregulated haunt of whalers and sealers and traders in timber and flax, conditions which lasted well into the nineteenth century. Then, in 1840, a race for the possession of New Zealand was narrowly won by the British, the Union Jack being hoisted on South Island only a few days before the arrival of a French frigate. In 1842 the French annexed the Marquesas, and later extended their influence in the east of Polynesia and in the south of Melanesia; New Caledonia was annexed in 1853.

German trading organizations appeared on the scene about 1855, and in 1872 an unofficial visit was made by a naval vessel to Fiji, where was then concentrated much of the trouble in the South Pacific arising from the activities of the traders and the kidnapping of natives. Annexation by the British Government was urged by both Australia and New Zealand, and this took place in 1874.

Well before the end of the century the interested Powers decided that the policy of annexation here and there and of the recognition of native states elsewhere was unsatisfactory. The impact of Europe had, indeed, brought chaos and destruction to the Pacific islanders, and the activities of traders were disturbing in many ways. Though the influence of missionaries was generally to mitigate the evils of unbridled commercialism, it was inevitably more limited in scope, and the methods used were not always based upon an understanding of the psychology and environment of the South Sea islander. The Pacific was the last area of the world (if the Antarctic continent be excepted) to be partitioned among the Powers. The Hawaiian group was annexed by the United States in 1898, this Power sharing the Samoan group with Germany in 1899. Germany had already secured North-east New Guinea (1884), as well as possessions in Northern

Melanesia and Northern Micronesia, while Spain sold her rights in the Carolines to the same Government in 1889. France, while retaining the possessions she had acquired during the eighteenth century (which included Indo-China), took over the government of the New Hebrides jointly with Britain in 1906.

The general process in the Pacific was the development of spheres of influence into protectorates, subsequently leading to annexation, and it should not be forgotten that the development of trade routes and the provision of trans-Pacific cables have been subsidiary factors in the final partition of the Pacific islands, which are now all allocated to European, American, or Asiatic states.

One important result of the impact of Europe upon the Pacific has been the large measure of depopulation of the indigenous inhabitants. Many causes have contributed to this. Neither Australia nor New Zealand ever carried a dense population, and settlement in Australia was little hindered by the aboriginals, who have steadily declined in numbers. In Tasmania the settlers carried on a war of extermination, and the last Tasmanian native died in 1876. When firearms came to the New Zealand Maoris inter-tribal wars and wars with the British had decimating effects, but the Maoris have in recent years tended slightly to increase. Many of the small islands in the Pacific were and are uninhabited, but the larger and more fertile ones frequently carried a considerable native population. Thus there were estimated to be 150,000 Tahitians in 1774; by 1880 the numbers had declined to 17,000, and further to 10,300 in 1899. The Marquesas Islands again have only a negligible fraction of the indigenous population. Fiji did not suffer such terrible depopulation, and here, as in some other groups, the decline has been arrested in recent years, and numbers of Indian settlers have been added.

The causes contributory to the decline include war and massacre, the raids for labour, which were unregulated until the last quarter of the nineteenth century, the introduction of European dress, of spirits, and of diseases that intercourse with Europeans brought with it. Smallpox took toll of the

Australian natives in the second year of the original settlement at Port Jackson. Measles and smallpox reduced the Fijians by 30,000 in 1875. Some points of missionary policy have also been somewhat ill-advised from this point of view, as, for example, the repression of dancing among peoples who naturally express themselves in this way. Some modern anthropologists, however, incline to the view that such decline is inevitable under modern conditions, apart from the operation of the causes indicated above: it is suggested that a subtle psychological factor is at work sapping the will to live of the indigenous races in face of the advance of Western influence.[1]

The natives have seldom taken kindly to the type of economic development in which Europeans are interested. Beyond Australia and New Zealand, the Pacific area is unsuitable for close white settlement; that is, economic development cannot be based upon white labour. It follows, especially in view of the decline in the native population, that economic activity must be largely based upon imported labour. Thus it is not surprising that many Asiatics are found in some of the islands. Actually, however, the economic activity is not, on the whole, very great, except in the Philippines and the Hawaii and Fiji groups. There are considerable numbers of Japanese in the islands now controlled by Japan and in Hawaii, while in Fiji are many Indians. Elsewhere Asiatics are relatively few. New Guinea, an enormous island susceptible of extensive tropical plantation development, has at present only an insignificant commerce. The nature of the commercial products varies; sugar, copra, and tropical fruits are very widespread, while some of the islands have considerable importance for their phosphatic deposits.

Cable and Coaling Stations

The principal cable centre in the Pacific is the island of Yap, in the Palau (Pelew) group of the Caroline Islands (Japanese mandate). A cable from San Francisco *via* Hawaii and Midway Island reaches Yap, linking up north-

[1] See *Population Problems of the Pacific* by S. H. Roberts (1927).

ward *via* the Bonin Islands with Yokohama, north-westward with Shanghai, and south-westward with the Dutch East Indies. North-east of Yap is Guam, which belongs to the United States and is a cable centre linked up with Yap and with Manila. From Vancouver a cable runs *via* Fanning

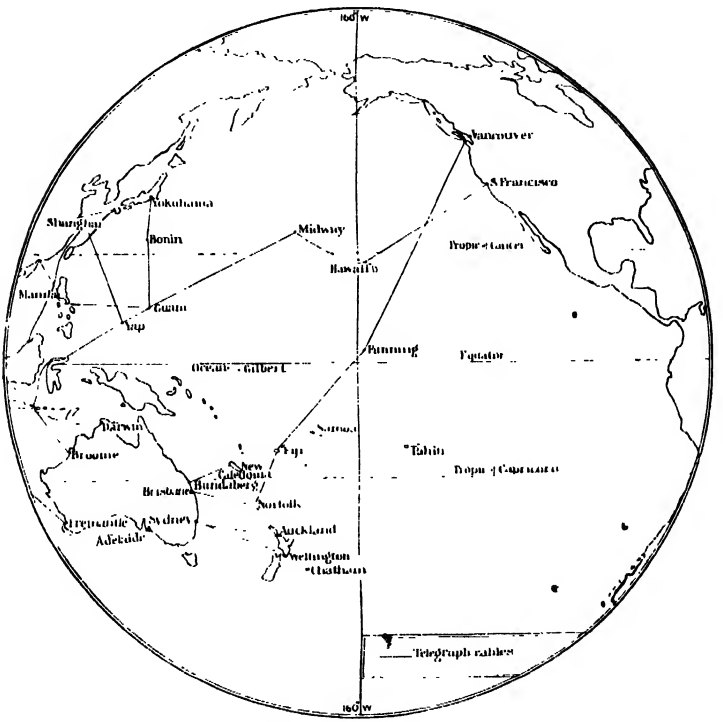

FIG. 10. TELEGRAPH CABLES OF THE PACIFIC OCEAN
Note that the central meridian of this map is 160° W.

Island to Fiji, reaches Auckland by way of Norfolk Island, and is then linked up with Sydney, which is also joined to Wellington. Other cables connect Southport, near Brisbane, with Norfolk Island, Bundaberg, some distance south of Rockhampton, with New Caledonia, and Singapore with Broome and Darwin in the north of Australia.

Wireless telegraphy has greatly facilitated inter-island communications, and the more important Pacific islands are now equipped with more or less powerful transmitting and receiving apparatus. The value of this to an island like Tahiti, which is without cable communication, is obvious.

FIG. 11. THE RADIO STATION, PAGO PAGO, TUTUILA, AMERICAN SAMOA

The harbour of Pago Pago occupies the crater of an extinct volcano

Photo E.N.A.

Over the vast expanse of the Pacific it is obviously desirable that coal should be available, and in this connexion Hawaii and Fiji are of particular importance. Tahiti, in the Society group, is a minor coaling-station. The most noteworthy ports in the Western Pacific at which coal may be loaded are Nagasaki, Hong-Kong, and Sydney. The

opening of the Panama Canal (1914) immediately heightened the importance of the Pacific Ocean; nevertheless, the volume of trans-Pacific traffic is small in comparison with that of trans-Atlantic traffic. The islands also have a possible future importance as stepping-stones on trans-Pacific air-routes.

The International Date Line

The great width of the Pacific makes this ocean very convenient for the adjustment of the logs of ships on eastward and westward voyages. Apart from certain variations which are a matter of political convenience, when crossing longitude 180° a ship travelling eastward counts two successive days as the same, and travelling westward drops a day.

Political Problems of the Pacific

The peoples of the Pacific margins comprise on the west and south-west the vigorous, dense population of Japan, with imperial interests on the mainland of Asia as well as in the island festoons and scattered Pacific groups north of the equator; the teeming millions of China, still struggling with internal disorder and with complex foreign relationships; the relatively dense population of South-east Asia, mainly under the domination of one or other of the Great Powers, including the United States, which came to the Philippine Islands in 1898; the white people of scantily populated Australia and New Zealand, with large empty spaces and jealously protecting their standard of life. Opposite are small and scattered areas of relatively dense population distributed along the otherwise almost empty margins of North America and South America. The peoples of North America, like those of Australia and New Zealand, are anxious to retain their lands for the white stock. Within the Pacific are the island groups, mainly in the western half, under varied political control and of immense strategic importance. If we except China, as suffering from the growing-pains of modernization and without any suggestion of imperialistic outlook, there are three Powers with

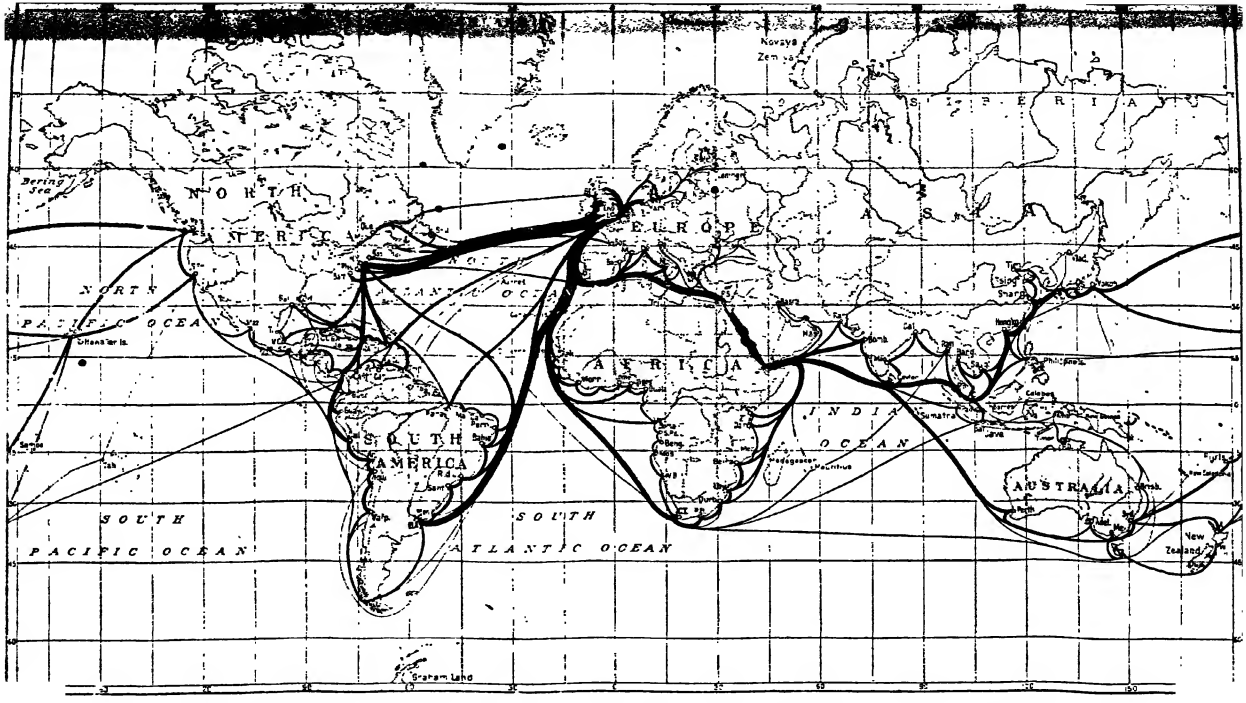

FIG. 12. THE PRINCIPAL SHIPPING ROUTES OF THE WORLD, SHOWING RELATIVE VOLUMES OF TRAFFIC

From "The New World: Problems in Political Geography," by Isaiah Bowman (The World Book Company, Yonkers-on-Hudson, and George G. Harrap & Co., Ltd., London)

dominant interests in the Pacific. These are Britain, the United States, and Japan.

Germany left the Pacific as a result of the Great War, and the German possessions were given over as mandates—the

FIG. 13. POLITICAL MAP OF THE PACIFIC IN 1914

For post-War changes see text.

From "The New World: Problems in Political Geography," by Isaiah Bowman (The World Book Company, Yonkers-on-Hudson, and George G. Harrap & Co., Ltd., London)

islands north of the equator to Japan and the others, including North-east New Guinea, to Australia and New Zealand, the latter in particular taking control over the Western Samoan islands, the remaining ones of which already belonged to the United States. Prior to the Great War the United States' possessions included islands centrally situated

in the North Pacific—the Hawaii, Midway, and Wake Islands—separated from the Philippines by the Ladrone, Marshall, and Caroline groups, which were German. The United States had for many years been suspicious of Japanese expansion, and had carefully regulated Japanese immigration into the western states. When Japan obtained the mandate for the intervening islands the United States were inevitably interested, since the result was to bring potential Japanese bases near to the Philippines. It should be noticed that the bulk of the United States' population and resources lie on the Atlantic side of the Rocky Mountains; the Panama Canal consequently has strategic as well as economic value in giving relatively easy access between the Atlantic and Pacific Oceans.

The fear of Japanese expansion has had important reactions on British imperial interests. Australia and, to a lesser degree, New Zealand have, quite apart from their desire to develop on the basis of a European population, always regarded with suspicion the encroachment of Powers other than Britain over the Pacific islands, particularly because of their remoteness from the mother country. The emptiness of Northern Australia, which is certainly susceptible of settlement by Asiatics, is a special matter of concern. There is an ever-present fear, not merely of Japanese imperialism, but of the pressure of population in the monsoon countries with convenient access to the empty spaces of the southern continent. These parts of the British Empire fall into line with the United States in closing the door to Asiatic immigration.[1]

It is clear that in a world in which armaments have not been abolished the Pacific contains all the elements of a conflagration. The interested Powers are fully alive to the situation, and the post-War years have seen some interesting developments. The Anglo-Japanese Alliance, which was due for renewal in 1920, was terminated. In 1921 a conference was called at Washington, at the instigation of the United States, to consider the limitation of armaments especially in relation to the Pacific, the principal Powers

[1] See *Problems of the Pacific*, edited by J. B. Condliffe (1928).

participating being the United States, the British Empire, France, Italy, and Japan; the conclusions reached in 1922 included provisions relating to China. On the question of armaments the principal clauses involved the limitation of tonnage, the building of capital ships for replacement only, and the maintenance of the *status quo* in regard to fortifications and naval bases in the Pacific east of longitude 110° E., so that there should be no extension or development of existing facilities. In the last connexion the new Singapore dock—only just outside the Pacific—has been criticized as violating the spirit of the Conference agreement. The Conference also made provision for the discussion of any Pacific questions that should become so acute as to endanger peace.

CHAPTER II

AUSTRALIA: GENERAL PHYSICAL GEOGRAPHY

CAPE YORK, on the Torres Strait, is in latitude 10° 41′ S., while Cape Otway, in Victoria, is in latitude 39° 8′ S., so that the Australian mainland stretches through about 28½ degrees of latitude (about 2000 miles). South Cape, in Tasmania, is in latitude 43° 39′ S. The extreme west (Steep Point) is 113° 9′ east longitude, and the extreme east (Cape Byron) is 153° 39′ east longitude, giving an extreme extension of 40½ degrees of longitude (about 2400 miles). The Tropic of Capricorn lies somewhat north of the extreme width, and nearly two-fifths of the area is in the tropical zone. The mainland covers an area of about 2,950,000 square miles, the total with Tasmania being about 2,975,000 square miles. The Commonwealth therefore has an area about twenty-five times that of the British Islands, and approximates to the area of Canada and of the United States, while, being only three-quarters of the area of Europe, it represents the smallest of the continental divisions.

The position and shape of Australia have considerable geographical significance. Its remoteness from Europe and its relative isolation, with great ocean expanses to the west, east, and south, were responsible for its late discovery and settlement, further delayed by the inhospitable character of the parts that were first touched. Moreover, its latitudes are such that the mainland is not only outside the equatorial belt of heavy and well-distributed rainfall, but does not reach the latitudes in which the westerly winds prevail all the year round. Its great extension about the Tropic of Capricorn—*i.e.*, in the latitudes of the south-east trade winds—is largely responsible for the aridity of much of the interior.

Australia is divided into three time-zones, Western Australia

keeping standard time eight hours in advance of Greenwich mean time, South Australia and Northern Territory nine and a half hours in advance, and the remaining political divisions ten hours in advance.

Further, in shape the continent is compact, yielding a coastline of 12,210 miles, or only one mile for 244 square miles of area. Excluding Tasmania, the proportion is one mile of coastline for 261 square miles of land, which compares with a proportion of 1 to 75 in Europe. The whole eastern coast is without any prominent gulf, and this is true of large stretches of the other coasts. The relative absence of large gulfs is, of course, related to the geological development of the continent.

Relief and Structure

An examination of the 100-fathom line surrounding Australia discloses the continental shelf as narrow on the western and eastern sides—narrowest where the Eastern Highlands are highest—somewhat broader on the south, where it expands to include Tasmania, and very broad on the north, reaching to New Guinea across the Gulf of Carpentaria and the Arafura Sea, though cut off from the Sunda Islands by a relatively deep trench. It is significant that a rise of 200 feet would join Tasmania to the mainland, and a rise of 100 feet would link up New Guinea. Beyond the continental shelf the sea-bed shelves rapidly to below 2000 fathoms on the west, south, and east, as also along the north edge of New Guinea; the Coral Sea also exceeds this depth.

Only about a quarter of the surface of Australia is below 600 feet in elevation, and most of this is a compact area of lowland marked by the Eyre basin and the Murray-Darling river-system. Elsewhere there is a relatively broad coastal lowland round the Gulf of Carpentaria, separated from the Eyre depression by a belt of land of no great elevation, indicated by the Selwyn Upland. The coastal margins of the north and north-west also show lowlands of appreciable width, but otherwise a small-scale orographical map emphasizes an absence of coastal plains. Indeed, long stretches of the coast are rocky or present steep cliffs to the sea.

On the other hand, there is an absence of land that can properly be called mountainous, and only a very small proportion of the continent exceeds 3000 feet, most of the land above this elevation being found in the south-east. From Cape York to Tasmania there is a belt of continuous, though dissected, highland, broken by the Bass Strait, and quite

FIG. 14. TYPICAL SURFACE OF THE GREAT BARRIER REEF
By courtesy of the Development and Migration Commission, Commonwealth of Australia

considerable areas, especially in New South Wales, rise above 3000 feet, an elevation which elsewhere in Australia is only reached in small and isolated areas toward the west, in Central Australia, and east of Lake Torrens and the Spencer Gulf. The total area exceeding 2000 feet (see Fig. 15) is also relatively small.

Most of Australia, therefore, is of moderate elevation, and, subject to modification in detail, it is possible to divide the continent into three broad physical regions: (1) the *Western Plateau*, covering nearly half the total area and roughly limited on the east by longitude 135° E.; (2) the *Central*

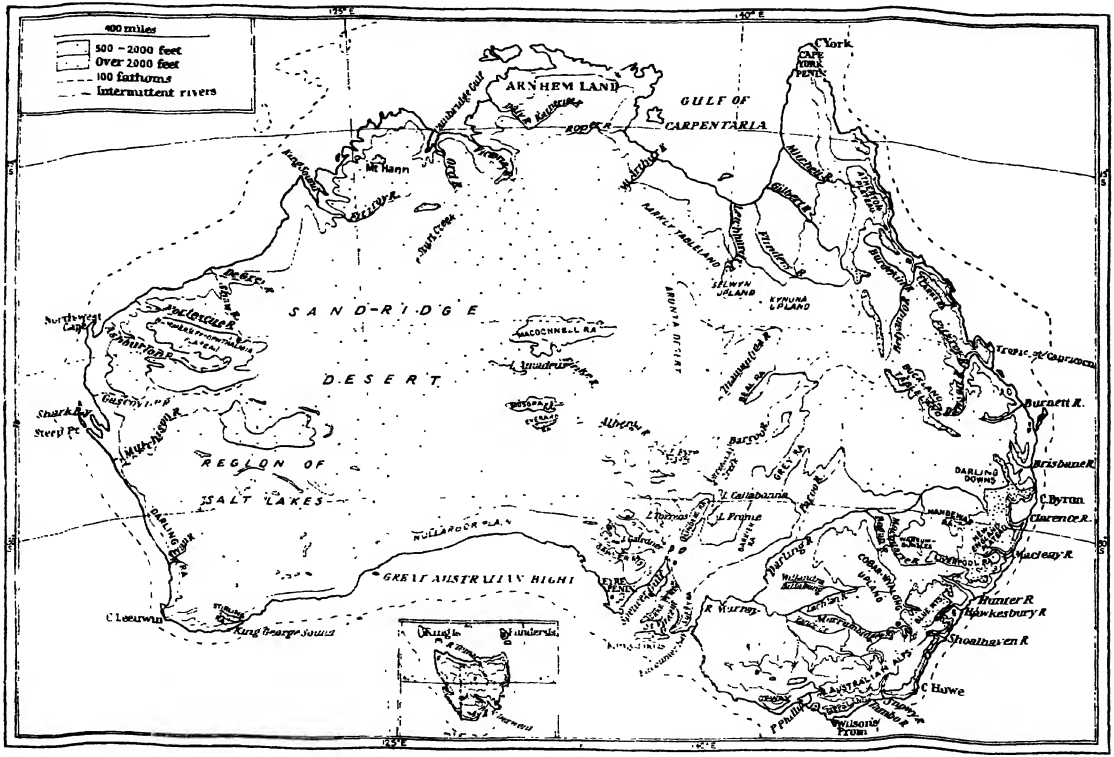

FIG. 15. AUSTRALIA—PHYSICAL

Lowlands, stretching from the Gulf of Carpentaria to the eastern coast of South Australia, with a maximum width approaching 1000 miles in the latitude of Lake Eyre, and divided into two main parts by a belt of tableland in the north-central region; (3) the *Eastern Highlands*, of varying

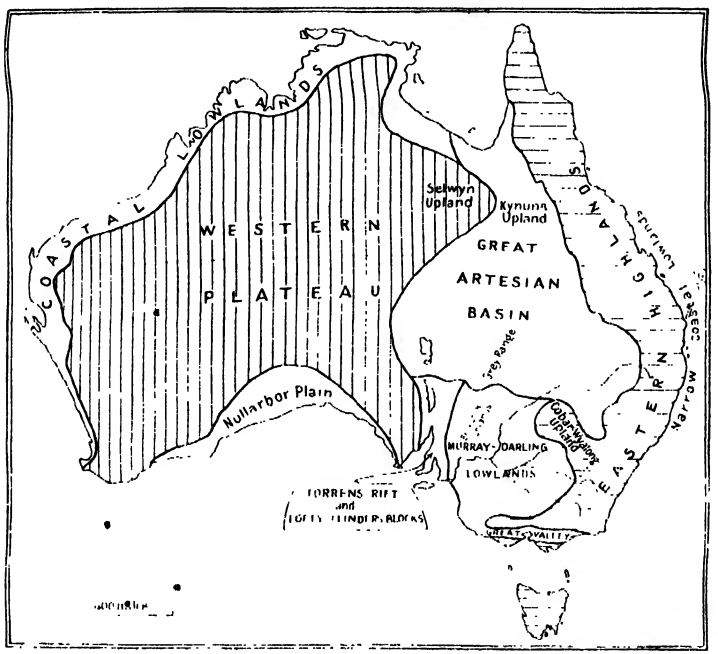

FIG. 16. AUSTRALIA: GENERALIZED STRUCTURAL DIVISIONS

width, running from Cape York to Tasmania, and presenting a steep front to the Pacific Ocean.

The two great trends of Tertiary earth-movements indicated in the west-to-east mountains of Asia and in the north-to-south island festoons to the east of that continent meet in the East Indies and New Guinea, and may be traced round to New Zealand. But they missed Australia, though a land connexion was maintained with New Guinea probably until after the close of the Cretaceous period. The mainland would

appear to have formed part of the ancient continent of Gondwanaland, and although its surface features, particularly in the eastern half, have been greatly modified as the result of subsequent earth-movements, most of it has been above sea-level since the end of the Primary period. The Western Plateau and the Eastern Highlands contain almost exclusively ancient or Primary rocks. Since that time there have been two great transgressions of the sea, and the Central Lowlands, together with the Nullarbor Plain, show younger rocks as a result of this encroachment. A great sagging movement in Cretaceous times allowed the sea to penetrate southward from the Gulf of Carpentaria to form a great gulf, which advanced as far as Lake Eyre, and the limits of which are roughly marked by the Great Artesian Basin. This area subsequently rose, but in later Tertiary times there was an advance of the sea from the south; the Australian Bight advanced to Lake Eyre, and submerged the Lower Murray region, while there was another, though smaller advance, southward from the Gulf of Carpentaria. At this time New Guinea and Tasmania were both joined to the mainland, and the present Great Barrier Reef marked the edge of the continent.

Other changes that have affected the continent include the relatively recent elevation of the eastern margin, so that the Eastern Highlands, although they consist of ancient rocks, now provide the highest relief. These highlands show considerable fracturing, associated with which occurred great outpourings of basalt. Finally, a certain amount of glaciation took place in the Kosciusko region of the south-east and in Tasmania.

The Western Plateau. This has an average elevation of about 1500 feet, and generally presents a steep scarp to the gently rising coastal plain, which has an average width of sixty to seventy miles. The scarp varies from 1200 feet to 2000 feet in elevation, and is especially noteworthy in the faulted edge of the Darling Range, behind Perth. The great peneplain of Australia was probably elevated in Pliocene times, and the movements that elevated the Western Plateau and the Eastern Highlands synchronized with the sagging

in the intermediate area. The plateau has experienced only minor changes since then, and the topography is largely the result of local earth-movements and the varying resistance of different formations to erosion. Minor oscillations are indicated by the occurrence of rias or drowned river valleys in the Kimberley District and Arnhem Land and by raised beaches and drowned valleys in the stretch of coast between Broome and Port Hedland; and while the Swan estuary and King George Sound in the south-west are both due to subsidence, the Stirling Range, behind Albany, is a horst (a raised earth block), and the Hammersley-Ophthalmia Plateau is bounded on the north by a well-marked fault overlooking the Fortescue river. The occurrence of fault scarps forming prominent features in the topography has led to the term 'range' being applied to many ridges which are not ranges in the sense in which that term is commonly used.

The rocks composing the southern half of the Western Plateau are mostly Archæan, metamorphosed igneous and sedimentary rocks, with Primary and younger rocks to the north and the Nullarbor Plain of Tertiary limestone to the south. The Nullarbor Plain is fringed on the north by Cretaceous rocks, and its limestone, which attains a thickness of 800 feet, presents a cliff of some 200 feet in elevation toward the south. The surface features of the plateau are diversified as the result of differential erosion and of the climatic conditions. Granite erosion scarps, known as 'breakaways,' are common, and the outstanding features of the Musgrave Mountains, notably Mount Woodroffe (5230 feet —the highest point of the Western Plateau), are masses of granite and gneiss. Ridges of very resistant quartzite mark the Macdonnell Ranges, in which Mount Heughlin reaches 4800 feet, and which, like the Musgrave and Gawler Ranges, indicate the old grain of the country running east and west; this region seems to have had an old river-system draining southward. In the desert regions occupying the east and central part of Western Australia mesas of no great height are sometimes found, while there are large areas of sand-dunes and undulating gravel desert (*cf.* the Sahara). East

and north-east of Perth are numerous salt lakes occupying shallow basins in the peneplain, largely the relics of a Tertiary drainage system that carried water to the Bight when the climate was wetter and the elevation lower.

The Central Lowlands. *The Eastern Highlands slope gently westward to the central plains, which, however, contain* certain areas of higher relief standing out prominently on the physical map. Such are the Barkly Tableland and the Selwyn Upland, which separate the drainage to the Gulf of Carpentaria from the Eyre basin of inland drainage; the Barrier and Grey Ranges, which divide the Eyre basin from the Murray-Darling basin; the Lofty and Flinders Ranges, which are generally referred to as the South Australian Highlands; and the Cobar-Wyalong peneplain, which projects westward from the Eastern Highlands into Central New South Wales. Broadly speaking, the uplands consist of Primary rocks largely of Cambrian age; the lowlands proper are of much younger and softer deposits.

One of the principal features of the Central Lowlands is the Great Artesian Basin, which marks the earlier southward extension of the Gulf of Carpentaria, and in which were deposited porous Triassic and Cretaceous sands, overlaid by blue clays and sandstone of an impermeable character. These deposits are upturned along the western edge of the Eastern Highlands, and their southern limit is so far south as to include Bourke and Lake Eyre; in the west their boundary is marked by the Barkly Tableland and Selwyn Upland (which are extensions of the Western Plateau) and by a series of mound springs[1] between Lake Frome and Oodnadatta. Across the northern part of the basin the Kynuna Upland, of no great height, separates the Flinders basin from the drainage to Lake Eyre.

In the south are three peninsulas and three gulfs. Spencer Gulf, a continuation of the Torrens rift valley, which is overlooked by the horst known as the Flinders Range, lies between the Eyre and the Yorke Peninsulas, the latter being left upstanding between Spencer Gulf and the St Vincent

[1] Springs of hot water charged with mineral matter, chiefly lime; the mound results from the deposition of dissolved material.

Gulf, a subsidence flanked on the east and south by the Fleurieu Peninsula and Kangaroo Island. East of this is Encounter Bay, referred to by Professor Griffith Taylor as the Murray Outlet Gulf, and containing Lake Alexandrina and the Coorong Lagoon. In late Tertiary times the sea penetrated far inland in this region, and the Darling, the Murray, and the Lachlan had separate mouths. A remarkable depression may be followed from the head of Spencer Gulf; Lake Torrens is separated from it by an area reaching only 100 feet, and between this lake and Lake Eyre, which is 39 feet below sea-level, is a divide rising to only 175 feet. Lower still is the divide between Lake Eyre and Lake Gregory and that between the latter lake and Lake Blanche, and the depression continues through Lake Callabonna to Lake Frome. This great depression almost encircles the Flinders block, which rises to 3470 feet in Mount Benbonyathe and to nearly 3900 feet in St Mary's Peak. The Lofty Range, which, like the main features of all this area, is due to buckling, does not rise so high (Mount Lofty is 2334 feet), and is bounded by step faults.

The lowlands of the Eyre and Murray-Darling basins are mainly filled with sheets of alluvium—gravel, clay, and loam often of considerable thickness. The surface, however, is varied; in the more arid regions desert erosion may give rise to flat-topped hills, to sand-dunes, or to the flat, stony areas known as the 'gibber' plains of Central Australia.

Other noteworthy features include the Barrier and Grey Ranges. The Barrier Range, a horst, 100 miles long by 30 miles wide, is sometimes referred to as the Broken Hill Upland, and consists chiefly of Silurian rocks, as does the Cobar-Wyalong peneplain, which seldom rises much above 600 feet, and separates the plains of the Barwon (Upper Darling) from the Riverina. There has been relatively recent vulcanism in the region between Kangaroo Island and Cape Nelson, in which low volcanic cones occur, especially in the Mount Gambier district.

The Eastern Highlands. Professor Griffith Taylor refers to the eastern belt of highland as a cordillera system, but this term suggests affinities to the western mountains of America,

and seems somewhat confusing. Actually the last large-scale folding in the continent brought up this region and an area to the east, since subsided, in Carboniferous times, since when it has been worn down to a peneplain, and again elevated, suffering considerable faulting and vertical movement, has been broken into tilted blocks warped up to different levels, and has had large areas of late Tertiary basalt superimposed upon it. Associated with the elevation of the highlands was the subsidence of the old coastal region

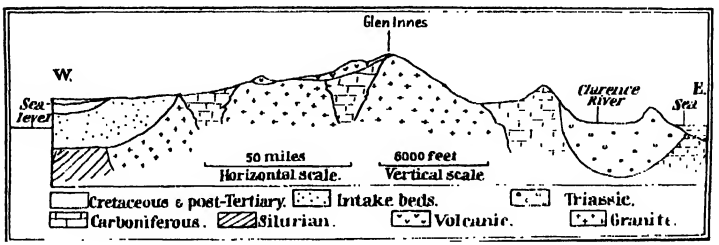

FIG. 17. SECTION ACROSS THE EASTERN HIGHLANDS IN NEW SOUTH WALES, BETWEEN LATITUDES 29° S. AND 30° S.

The diagram shows the block character of the Eastern Highlands and the extensive development of igneous rocks. Note the relation of the intake beds of the Great Artesian Basin to the highlands. This is an eastward continuation of the section given on p. 90.

Based on a diagram in the "Mineral Resources of New South Wales" (New South Wales Geological Survey)

to the east, the edge of which is indicated by the Barrier Reef.

In general the Eastern Highlands are broader and lower in the north than in the south, and reach their greatest elevation in the south-east, just before taking an east-to-west trend in Victoria. The term 'Dividing Range' frequently appears, and though this is useful as indicating the watershed between the coastal rivers and the west-flowing rivers, there is no proper range, but a series of disconnected plateau blocks. Before the vertical movements of the Tertiary period the divide was generally farther east than at present, and was particularly associated with large areas of granite exposed by long denudation. The Tertiary changes and especially the lava flows, together with the rejuvenated coastal rivers, have brought about the present divide, so

that large areas of granite lying relatively near to the coast may be traced from Tasmania to Cape York.

In Queensland one of the chief features is the Atherton Plateau, composed mainly of Carboniferous rocks, situated behind Cairns; it is highest near the coast, where Mount Bartle Frere reaches 5348 feet. A broken belt of high land over 3000 feet—broken particularly by the Burdekin river—stretches from here to near Mackay, and consists largely of granite. From the Atherton Plateau, behind Cairns, a tongue of land mostly over 3000 feet runs south and then south-east to form the Great Dividing Range, including the Buckland Tableland just south of the Tropic of Capricorn. The Buckland Tableland, like the Darling Downs, which lie to the south-east of it, but at a somewhat lower elevation, is covered with sheets of basalt, and a number of volcanic cones of the late Tertiary period are found in the Glasshouse Mountains, which separate the Darling Downs from the Brisbane lowland.

In the north of New South Wales is the New England Plateau, much of it over 3000 feet, and reaching 5000 feet in Ben Lomond and other points. It is largely composed of granite, and sends a high spur—the Macpherson Range—toward the coast along the boundary with Queensland. To the west is the volcanic area known as the Nandewar Range, reaching about 4000 feet, while to the south the New England Range merges into the Liverpool Range, exceeding 3000 feet, capped with basalt and linked on the west to the Warrumbungles, another volcanic area. Then comes the Cassilis Gap, a well-defined gap behind Newcastle that but little exceeds 1000 feet, and for which faulting and river erosion are responsible.

South of the Cassilis Gap are the Blue Mountains, a folded and faulted massif consisting of Silurian slates and limestones, with intrusive igneous rocks, and flanked to the east by hard Triassic sandstone that makes the steep escarpment to the west of the Nepean river and flattens out to form the lowlands behind Sydney; underlying this sandstone are the principal coal measures of the Commonwealth. The Blue Mountains reach 4000 feet near the source of the Macquarie

river; they are marked by deep gorges made by the relatively short rivers draining to the coast, and the steep escarpment long prevented penetration to the interior.

Lake George is in a depression, marked by numerous faults, which provides a relatively easy route but little ex-

FIG. 18. IN THE BLUE MOUNTAINS
Dissected plateau country.
By courtesy of the Immigration Office, Commonwealth of Australia

ceeding 2000 feet between the coast of New South Wales and the interior plains; to the south of it lies the Monaro Plateau, which contains the highest land in Australia. This tableland, flanked by granite, has a general level of over 5000 feet, and rises in the boss of Kosciusko, in the Snowy Mountains, to 7328 feet; evidences of recent glaciation—cirques, moraines, and tarns—mark its slopes down to about 5500 feet. The extension of this highland area out to Cape Howe is an important feature of this corner of the continent.

The Snowy Mountains mark the change of direction of the

highlands into Victoria, in which state the high relief consists of the same type of block mountains. The highest elevations are in the east, where Mount Bogong and Mount Hotham both exceed 6000 feet in an area known as the Dargo High

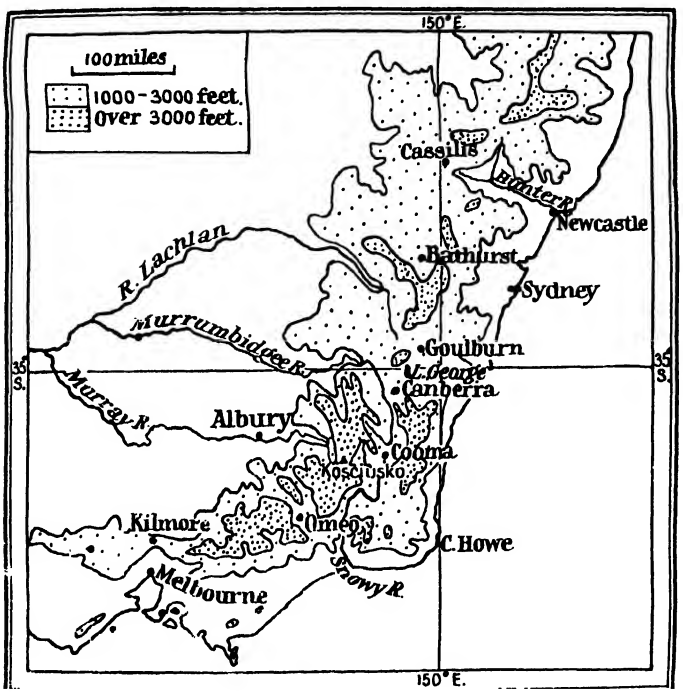

FIG. 19. THE HIGHLANDS OF SOUTH-EAST AUSTRALIA

Note the various gaps, of which the Kilmore, Goulburn, and Cassilis are the most important.

Plains. Toward the longitude of Melbourne the height rapidly falls to about 1000 feet in the Kilmore Gap, to the north of that city. To the west of the Kilmore Gap the highlands are known as the Pyrenees, reach 3324 feet in Mount Macedon, and then terminate in the horst of the Grampians, to the west of Ararat. South of the Dividing Range is the Great Valley of Victoria, bordered on the south

by the Otway and Gippsland highlands. These consist of Jurassic rocks, though the noteworthy projection of Wilson's Promontory is a granite mass. The Great Valley is divided into western and eastern portions by Port Phillip; the western half is covered with basaltic lava flows, numerous cones, some exceeding 1000 feet, being met with.

FIG. 20. THE KOSCIUSKO MASSIF FROM THE UPPER MURRAY

The stream is the Corryong Creek, a small tributary of the Murray, in the extreme north east of Victoria.

By courtesy of the Immigration Office, Commonwealth of Australia

The coastal plains of the east are generally very narrow, as in general faulting and subsidence have produced the coastline, though there have been local oscillations. A few tongues of lowland penetrate inland, notably along the Fitzroy, Burnett, Brisbane, and Hunter rivers.

Tasmania is a rugged block similar in structure to the highlands of Victoria. It is a dissected plateau of older Primary rocks, with granite masses in the east and north-east, while in the centre and south-east exists a coal basin

of similar age to that of New South Wales and largely covered with basaltic flows. In the north and central parts of the island the plateau, which has an average elevation of almost 3500 feet, reaches 5069 feet in Cradle Mountain. This plateau presents a steep edge to the north, west, and east, and falls more gently to the Derwent, which has eaten deeply into it. The highest point is Legge's Peak (5160 feet), in the Ben Lomond district of the north-east. The highest parts of the island show evidences of glaciation similar to those of the Australian Alps.[1]

DRAINAGE

Maps of Australia are somewhat deceptive in that they show many long rivers and numerous sheets of water that by no means reflect the general aridity of much of the continent. Thus Lake Eyre, flowing into which the map shows a number of apparently large rivers, is not a great sheet of water, and the rivers are of the wadi type, with only a seasonal flow.

Rivers. Two-thirds of the area has no drainage to the sea. Most of this is a compact region in the central part of the continent, including a great part of Western Australia, South-west Queensland, North-west New South Wales, and most of South Australia; it reaches the coast of the Great Bight, where for nearly 1000 miles no water discharges into the sea. A smaller area of inland drainage is met with in the Wimmera district of North-west Victoria, where many streams fail to reach the Murray across the dry plains. The interior portion of the Western Plateau is devoid of running water, and only in the eastern portion of the main area of inland drainage are there any streams of considerable magnitude; these include Eyre's Creek, the Diamantina, and the Barcoo (which becomes Cooper's Creek). These may have a great volume of water in their upper and middle courses during the flood season, when the summer rains fall, but they degenerate into water-holes or even disappear altogether

[1] A detailed account of the topography of Australia by Professor Griffith Taylor appears in the Commonwealth *Year-book* for 1927, No. 20.

in the dry season. They take such water as they can into Lake Eyre, though Strzelecki Creek may connect Cooper's Creek with Lake Blanche, Lake Callabonna, and Lake Frome.

Round the western and northern edges of the Western Plateau are many relatively short rivers which again have only a seasonal flow. In the north the Roper, Daly, Vic-

FIG. 21. THE BARRON GORGE, NEAR CAIRNS, NORTH QUEENSLAND

A gorge developed in the steep escarpment in a region of heavy rainfall. Note the forest, and the railway level seen the right.

Courtesy of the Immigration Office, Comm. wealth of Australia

toria, and Fitzroy are among the largest, and these rivers are much better supplied with water than the De Grey, Fortescue, Ashburton, Gascoyne, and Murchison rivers that mark the coast on the west. Most important of the rivers of the west is the Swan, which drains part of the well-watered Darling Range, has its maximum flow in winter (which is the rainy season), and runs into a drowned estuary; it has no value for navigation.

The nearness to the Pacific coast of the Eastern Highlands,

which receive a considerable rainfall, leads to relatively short, torrential east-flowing rivers, and the comparatively recent elevation of these highlands (accompanied by faulting), together with the lava flows and the heavier rainfall on the eastern side, has resulted in deeply cut gorges and valleys and many examples of interference with the earlier drainage system, while many waterfalls occur, especially in Queensland. Prominent among the Queensland rivers is the Burdekin, which, with its tributary the Belyando, drains a considerable area of that state north of the tropic. Interlocked with its drainage system is that of the Fitzroy, which has north-and-south tributaries and reaches the coast at Rockhampton. Farther south the rivers are shorter; notable among them are the Brisbane river, the Hunter (the largest river of the New South Wales coast), and the Hawkesbury. It should be noted that, though liable to flood, these eastern rivers are normally well supplied with water; in many cases they are navigable for fifty miles or more in their lower courses, though their mouths are often obstructed by sand-

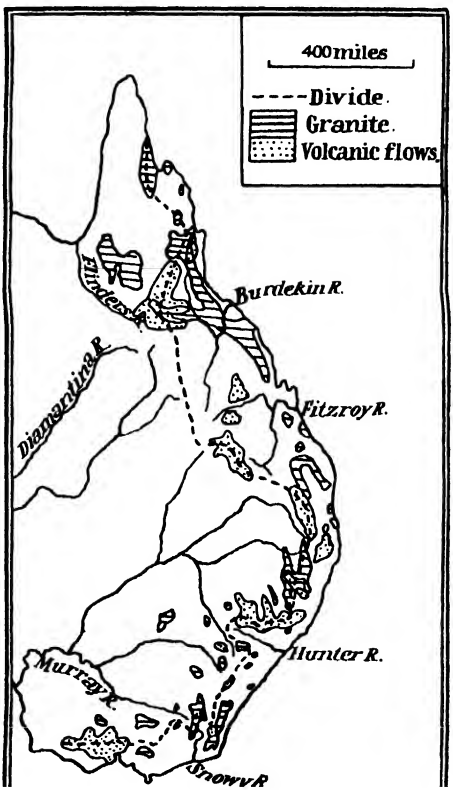

FIG. 22. IGNEOUS AREAS OF THE EASTERN HIGHLANDS

The divide largely follows the later volcanic outcrops.

bars, as with the Burdekin, Shoalhaven, and many of the streams of New South Wales; this is largely due to the sand-drift caused by the East Australian Current. In Victoria the Snowy river (which rises in New South Wales in a rift valley in the neighbourhood of Mount Kosciusko) is a feature of the southern coast, while the Yarra drains westward into Port Phillip.

Longer rivers flow westward from the highlands; of those flowing to the Gulf of Carpentaria the Flinders is the most considerable, while the chief streams feeding the inland drainage area have already been mentioned.

There remains the largest and the most important river basin in Australia, that of the Murray-Darling. This basin covers about half a million square miles, and besides draining the inner slopes of the highlands in Victoria and New South Wales, also drains the Darling Downs. The Murray itself rises in the Snowy Mountains, the highest and one of the best-watered areas in the continent; as snow is retained here for the greater part of the year it follows that the Murray is better supplied with water than most other Australian rivers, and is much more likely to have a permanent flow, though in very dry weather it fails in its lower course. The river is 1600 miles long (for three-quarters of which it constitutes the boundary between Victoria and New South Wales) from its source to its mouth in the shallow lagoon of Lake Alexandrina, but as the plains absorb all their rainfall the supply to the main river is derived exclusively from the highlands, and especially from the headstreams of the Murray itself, which include the Mitta. These headstreams debouch from long, winding, and usually narrow steep-sided valleys, to meander over the plains. Apart from the water removed for irrigation purposes, the loss of water (*cf.* the Orange and the Nile) is so considerable that it is not surprising that sometimes sea-water flows into the lagoon and penetrates for some miles up the river. A feature of the lower course is that in passing across the Tertiary plains the river has been diverted southward at Morgan by the uplift of the Lofty Range. The river falls only 57 feet in nearly 400 miles of its course in South Australia

Its largest tributary is the Darling, which, starting in the Barwon in the Darling Downs, has a course of some 2300 miles, if the Lower Murray be included. In times of heavy flood it may be a great river flooding its banks to a width of 100 miles and taking considerable quantities of water to Wentworth, at its junction with the Murray. The Murrumbidgee, with its tributary the Lachlan, is perhaps more important; the former stream has an upper course occupying a rift valley to the north of the Monaro Plateau, and in flood times may connect directly with the Murray *via* the Yanco Creek. Of the few Victorian tributaries the Goulburn is the most important.

As highways the Murray and its tributaries have only limited value, a value not commensurate with their mileage and with their impressive appearance on the map. When in flood the Murray is navigable up to Albury and the Darling to Walgett, above Bourke, but their use is chiefly local. As the Murray flows through flat and scantily watered alluvial plains the development of irrigation has received so much attention that to make the river an important channel of water communication—now being attempted is a task of great difficulty; it involves not only the course of the river itself, but also its lagoon outlet, across which the bar gives at present from 7 to 12 feet of water.

The relatively steady *régime* of the rivers of Tasmania is almost without parallel on the mainland.

Lakes. Australia is poor in lakes, except in basins occupied merely by salt swamps. Lake George, situated on the divide near the source of the Murrumbidgee, is twenty miles long, and the largest lake deserving the name in the continent; its origin is due to faulting, for it is overlooked on the west side by a fault scarp. Even this lake is brackish, and varies considerably in size. The lakes which on the map seem striking sheets of water are not really such, but are saline flats, dry or muddy according to the amount of water that manages to reach them. Such are Lakes Amadeus, Macdonald, and Disappointment and the large basins that occur in South Australia. In the south-west quadrant of Western Australia are a large number of long but relatively narrow

salt 'lakes,' occupying hollows in the plateau and probably relics of a drainage system that flowed to the Bight under wetter climatic conditions.

Lake Eyre is more interesting than important. The descriptions given of it vary, because of the varying amounts of water that reach it. It consists of two parts, northern and

FIG. 23. LEG OF MUTTON LAKE, MOUNT GAMBIER, SOUTH AUSTRALIA
It occupies part of the caldera of Mount Gambier.
By courtesy of the Immigration Office, Commonwealth of Australia

southern, the northern being much the larger, and lies at 39 feet below sea-level; terraces indicating much higher levels, however, surround it up to 180 feet above the present surface. An aerial reconnaissance in 1922 showed a large area of water in Lake Eyre North, but during an expedition in 1929 a heavily laden motor-lorry was taken across part of it. The 'lake' was then stated to present a surface "like a frozen sea, with a layer of salt up to fifteen inches thick, with a pinkish tint," while bore-holes sunk to twenty feet

gradually filled with brine. The deposits consist chiefly of salt and gypsum.[1] Lake Torrens, at a level of 98 feet, appears to be similar; into the southern part some flood-water from the Willochra Creek occasionally flows. At one time Lake Eyre probably drained to it, and its southern end, choked with sand, is connected with Spencer Gulf by a series of lagoons. These lake-basins are kept moist below the surface by underground seepage (Lake Eyre is within the Great Artesian Basin), and are situated in an area which in recent years has suffered terribly from drought.

Among other lake-formations may be mentioned the billabongs (ox-bow lakes) which are found along the rivers in the lowlands; the lagoons of some sections of the coast, such as the Gippsland lakes behind the Ninety-mile Beach of Victoria; the small lakes in the basalt area of South-west Victoria, some being crater lakes; and the lakes of the central plateau of Tasmania.

Climate[2]

A fundamental consideration in the discussion of the climate is the latitudinal position of the continent. It stretches along the Tropic of Capricorn in the belt of the relatively dry south-east trade winds, and some 38 per cent. of the area lies within the tropics. Its northern margins do not reach the belt of well-distributed rainfall that lies along the equator, but are in the summer rain belt; the southern margins do not reach the latitudes in which the wet westerly winds prevail all the year round, but are in the latitudes associated with rain of the Mediterranean type, though Tasmania, lying in the forties of latitude, is subject to depressions from the west all the year round. Ignoring the effect of elevation, the lowest noon altitude of the sun even in Tasmania[3] is such as to ensure a mean temperature that

[1] This arid basin has been described by Professor J. W. Gregory in *The Dead Heart of Australia* (1906).

[2] For a full account see *Australian Meteorology*, by Professor Griffith Taylor (1920).

[3] About 23° in the south of the island, but the warming effect of the sea in winter must also be borne in mind.

may be described as mild, while the strong insolation in summer over the northern and central parts yields high temperatures, which, however, fall short of those in corresponding latitudes north of the equator in Africa and parts of Asia, as the continental effect is not so marked.

The part played by ocean currents in modifying the climate is not so prominent as in the other southern continents. The West Wind Drift divides about Cape Leeuwin, and sends a branch of cool water for the greater part of the year across the Bight and another branch northward along the west coast. Associated with the latter branch is no very strong upwelling of cool water such as is evident in corresponding latitudes off the west coasts of South Africa and South America; in consequence there is little modification of the coastal temperature and no striking contrast between the temperatures of the east and west coasts such as the other continents show. Moreover, the west coast is not quite so devoid of rainfall as are the corresponding margins of Africa and South America.[1]

The South Equatorial Current, flowing westward across the Pacific Ocean, is divided by the New Hebrides and New Caledonia into two drifts, one passing across the Arafura Sea into the Coral Sea and sending a branch southward past the Great Barrier Reef, the other curving south-west past New Caledonia to link up with the Queensland Drift as the East Australian Current. This passes the coast of New South Wales at a rate of one to three knots, is more obvious in the summer, and turns eastward about latitude 31° S. Off the north and north-west coasts the direction of the warm drifts is affected by the monsoons.

These warm currents no doubt assist in maintaining a high average temperature along the north and east coasts, especially in view of the fact that the water in the Gulf of Carpentaria and round the adjacent peninsulas has a mean surface temperature of over 80° F. But the principal result is in the increase of the humidity of the air round the northern and eastern shores, with a corresponding increase

[1] For a discussion of this subject see the volume on *Africa* in this series.

in the rainfall along those margins when on-shore winds are blowing.

An important factor in the meteorology is the high-pressure belt that lies about the latitudes of the southern half of the continent, migrating somewhat north and south with the movement of the vertical sun. This is properly to be regarded as a belt of eastward-moving anticyclones, the course of which is generally across Central Australia in winter and along the southern margins in summer. These

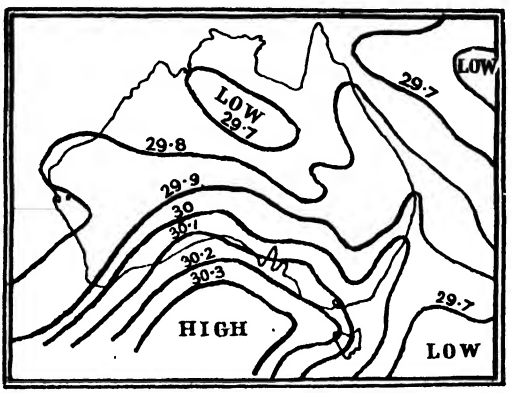

FIG. 24. AUSTRALIA—A TYPICAL PRESSURE DISTRIBUTION IN SUMMER

The high-pressure area is affecting the south of the continent; monsoon conditions prevail in the north.

traverse the continent relatively close together, and it is only when they are separated by a well-marked trough of low pressure that the interior receives any very appreciable precipitation, associated with the front of the eastward-moving trough. When the track of the anticyclones is farthest south—*i.e.*, in summer—the north and north-east are under the influence of depressions associated with the monsoon developed at that season, while in winter the depressions associated with the west wind belt affect the southern margins. Tasmania is influenced by the latter kind all the year round.

Another factor of general significance is the distribution

of highland. Owing to the Eastern Highlands being set athwart the south-east trade winds, there is an obvious barrier to the penetration of moist winds from the Pacific Ocean, while the absence of prominent relief in the western plateau hinders precipitation over a vast area of arid territory. On the other hand, relatively high relief has local importance in connexion with rainfall, as with the Darling Range and the South Australian Highlands. Over the

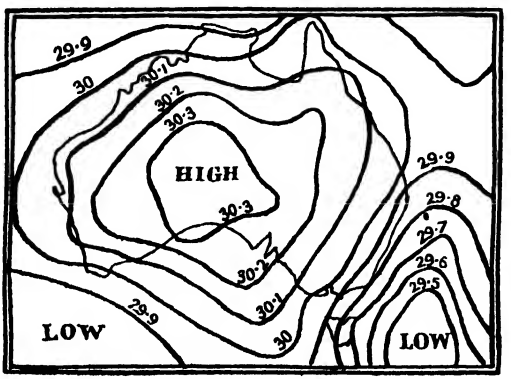

FIG. 25. AUSTRALIA—A TYPICAL PRESSURE DISTRIBUTION IN WINTER

Anticyclonic conditions prevail over the land-mass, while depressions affect the southern margins.

greater part of the area the modification of temperature due to altitude is not such as to need very great stress, though this again has local importance especially in the south-east.

From the foregoing considerations it can readily be understood that the rainfall of Australia is mainly peripheral. An examination of the map of the mean annual rainfall shows that the belt of rainfall exceeding 20 inches makes a crescent round the north, east, and south-east coasts, with outlying areas in the south-west corner and in Tasmania, while a large area receiving less than 10 inches stretches from the Eyre basin to the neighbourhood of Shark Bay; this arid region approximates to a million square miles.

Summer Conditions. Owing to the position of the vertical

sun insolation is intense over the greater part of the continent and considerable in the south. Distance from the sea and aridity of the interior, combined with a high altitude of the sun, yield a large area in the north-central part with a mean January temperature of over 85° F., 90° F. being exceeded

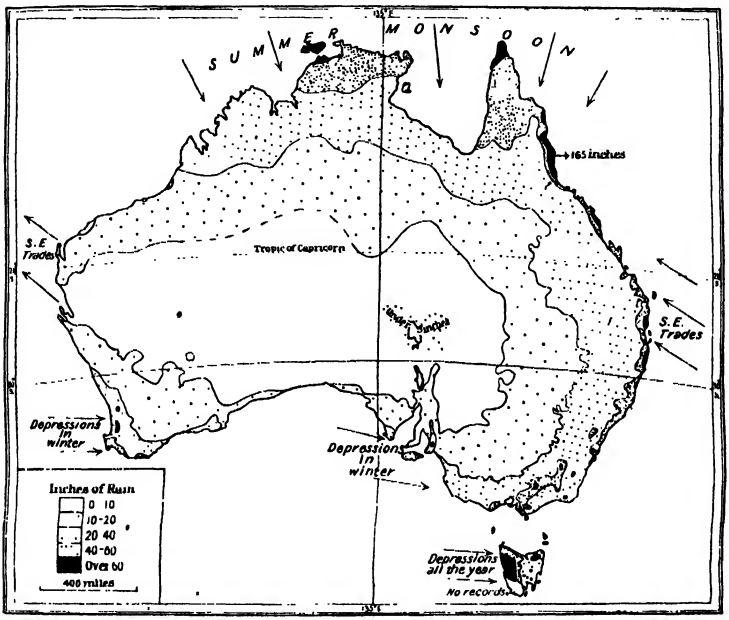

FIG. 26. AUSTRALIA—MEAN ANNUAL RAINFALL

Note the heaviest rainfall in the neighbourhood of Innisfail, backed by the Bellenden Ker Mountains.

in a region round the Fortescue river. The heavy monsoon rainfall of the north and north-east coastal regions somewhat modifies the temperature, although even in these parts it exceeds 80° F. South of the hot north-central belt temperatures decline, the northward bend of the January isotherms near the east and west coast illustrating the moderating influence of the sea. Perth, Adelaide, and Sydney all average more than 70° F. in this month, and the 60° F. isotherm passes through the middle of Tasmania, although the position

of Hobart in the Derwent valley gives it a temperature somewhat exceeding this figure. The effect of elevation is illustrated by Kiandra, a station at 4640 feet, in the Kosciusko region, where the mean temperature for the hottest month (February) barely reaches 59° F.

Following the southward migration of the vertical sun

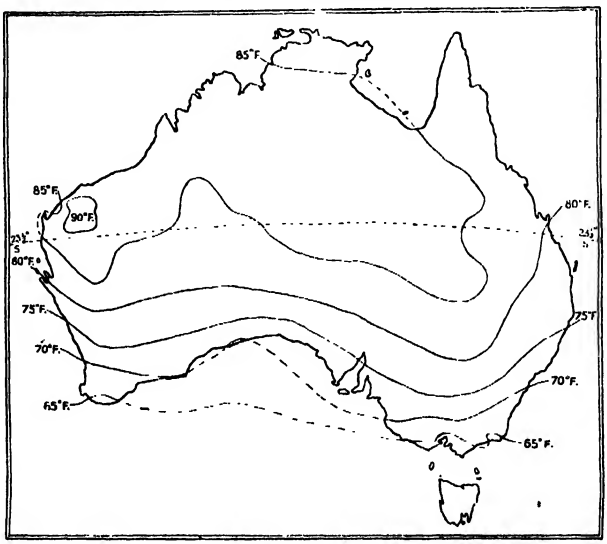

FIG. 27. AUSTRALIA—MEAN SEA-LEVEL ISOTHERMS FOR JANUARY

Note the continental heat of the northern interior.

comes the movement of the equatorial belt of rainfall, resulting from the intense heating of the north-central interior; the isobars for January show that in this area low pressure prevails, leading to the development of the monsoon. Winds blow from the warm seas to the north and north-east of the continent, being deflected to the left by the operation of Ferrel's Law and bringing heavy rain to Arnhem Land, the Carpentaria region, and the seaward margins of the Queensland highlands, the Bellenden Ker Hills receiving the largest amount. The coastal margins of New South Wales share in this rainfall, though to a lesser degree, and inland from

this marginal belt of heavy rain precipitation declines; in this connexion the limit of the summer type of rainfall should be noted from the map (Fig. 31). The relatively high pressure of the Bight area is related to the summer drought of the southern and south-western regions, but Tasmania, owing to its latitude, is subject to depressions, which bring a considerable rainfall to its western highlands. Typical mean rainfalls for December to February inclusive are those

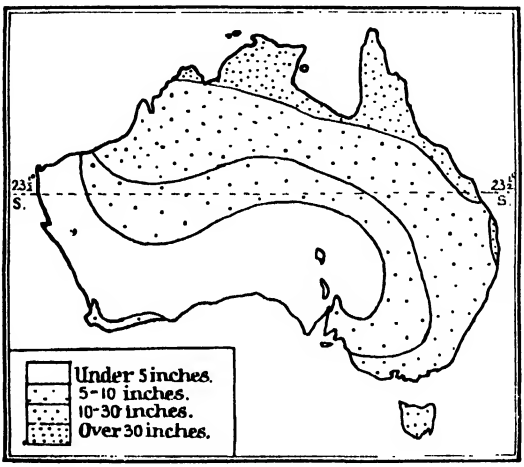

FIG. 28. AUSTRALIA—MEAN SUMMER RAINFALL, NOVEMBER TO APRIL INCLUSIVE

of Darwin (36·8 inches), Harvey Creek (near the Bellenden Ker Hills) (64·8 inches), Brisbane (17·75 inches), Sydney (10·7 inches), Daly Waters (16·9 inches), Cloncurry (13·0 inches), Bourke (5 inches), Alice Springs (4·8 inches), Perth (1·36 inches), Adelaide (2·45 inches), Melbourne (5·9 inches), and Hobart (5·3 inches).

Winter Conditions. With the migration of the vertical sun northward temperatures decline considerably. No part of the continent in July shows a mean temperature exceeding 80° F., although the extreme north approaches it (Darwin, 77° F.). From this hot northern region temperatures fall southward roughly with latitude, though distance from the

sea is responsible for the well-marked northward arch of the July isotherms in the south of the continent, interior districts in Victoria and New South Wales showing markedly lower mean temperatures than the corresponding latitudes on the coast. The greater part of the interior of New South Wales and nearly the whole of Victoria show a mean temperature in this month of below 50° F., and there is a similar area

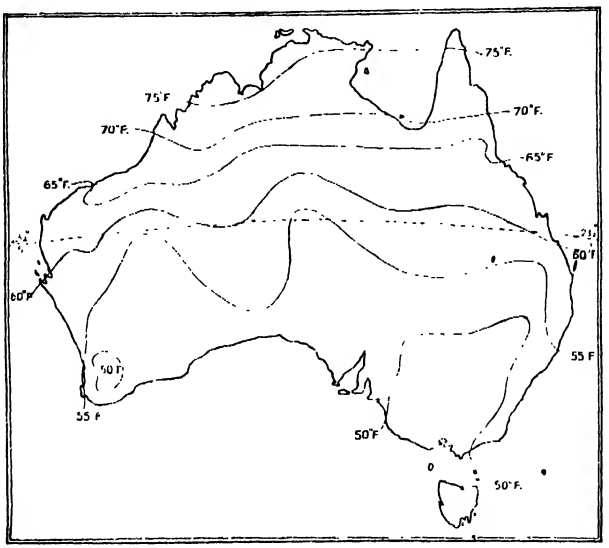

FIG. 29. AUSTRALIA—MEAN SEA-LEVEL ISOTHERMS FOR JULY
The most obvious continental effect is seen in the south-eastern interior.

enclosed by the 50° F. isotherm behind the Darling Range in Western Australia. Nevertheless, it is clear that at sea-level even in the south of the continent mean temperatures in winter permit plant growth, although it may be noted that the elevated station of Kiandra shows a mean July temperature of barely 32° F. Hobart, in latitude 43° S., shows a mean temperature in this month of nearly 46° F., a mild winter comparable with that of the extreme south-west of England.

High pressure prevails at this season over the south-central

part of the mainland, hindering the penetration of rain into the region that receives a negligible rainfall in summer, and resulting in the area north of the tropic being subject to prevailing south-easterly winds. Rain is precipitated on the eastern margins of Queensland, though far less heavily than in summer, but behind the highlands the amount is negligible; Harvey Creek and Brisbane average 17·6 inches and 7·3 inches of rain respectively for June to August inclusive,

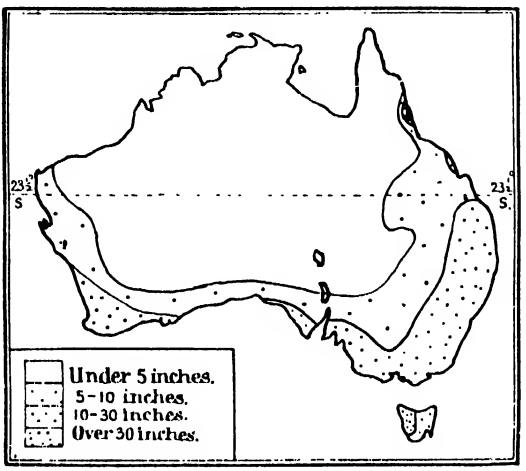

FIG. 30. AUSTRALIA MEAN WINTER RAINFALL, MAY TO OCTOBER INCLUSIVE

Cloncurry receiving only 0·9 inches. The southern half of the continent has its rainy season, as the belt of depressions has migrated northward. These depressions bring substantial quantities of rain where high relief stands in their path, as with the Darling Range and the South Australian and the Victorian highlands, a fact of considerable economic significance, but it is not surprising that the Bight coast, although in similar latitudes, does not receive any considerable amount. It is noteworthy that this cyclonic rainfall is felt, though not very appreciably, as far north on the west coast as North-west Cape. Depressions are responsible for a fair winter rainfall along the coast of New South Wales and for

a smaller precipitation in the interior of this state. Tasmania has a heavier rainfall than in summer, as the disturbances are more intense and frequent. Typical mean rainfalls for June to August inclusive in the south and south-east of the continent are those of Perth (19·3 inches), Eucla (3·0 inches), Adelaide (8·3 inches), Melbourne (5·8 inches), Sydney (12·5 inches), Bourke (2·8 inches), and Hobart (6·2 inches).

The table on p. 83 gives the mean monthly temperatures and rainfall for each of the state capitals. No meteorological station is situated above 200 feet.

Other Climatic Features. As is so often the case, mean figures and broad generalizations mask many climatic features of profound importance in human and economic geography.

The annual range of temperature, which increases southward and inland, is nowhere excessive, as the continent is relatively small, and does not reach high latitudes. Thus typical annual ranges of temperature for towns on or near the coast are those of Darwin (8·5° F.), Brisbane (18·5° F.), Sydney (19° F.), Melbourne (19° F.), Adelaide (22° F.), Perth (19° F.), and Hobart (16·5° F.), while interior stations like Charleville and Alice Springs have ranges exceeding 30° F. The daily range of temperature may, however, be considerable, and extreme readings show that great contrasts are experienced during the year over most of the continent. Thus ground-frosts in winter occur everywhere except along the northern and north-western margins, and of the stations mentioned above the minimum air temperature recorded has reached or gone below freezing-point at Melbourne, Adelaide, and Hobart. In the interior the heat of summer may be excessive and prolonged, with the shade temperature well exceeding 100° F. for many successive days, and even Hobart has recorded maximum temperatures exceeding 100° F. It should be noted that summer occurs in Australia about the time of perihelion, and that extreme readings should also be related to the humidity of the air.

No consideration of temperature is adequate without reference to the humidity of the air. It is the amount of moisture in the air, rather than the actual temperature, which affects

Climatic Figures for the State Capitals

City	—	Jan.	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Range	Total Rainfall
Perth	° F.	73·8	74·0	71·1	66·8	60·7	56·8	55·2	56·0	58·3	60·6	66·1	70·8	18·8	—
	In.	0·35	0·44	0·80	1·64	4·97	6·92	6·66	5·77	3·45	2·21	0·79	0·57	—	34·57
Adelaide	° F.	73·8	74·0	69·8	64·0	57·9	53·5	51·8	54·0	57·1	61·9	67·0	71·1	22·2	—
	In.	0·72	0·74	1·03	1·73	2·77	3·11	2·64	2·51	2·05	1·73	1·14	0·99	—	21·16
Melbourne	° F.	67·4	67·6	64·5	59·4	54·1	50·4	48·7	51·0	54·2	57·7	61·3	64·9	18·9	—
	In.	1·92	1·74	2·21	2·15	2·17	2·06	1·84	1·86	2·41	2·62	2·21	2·26	—	25·45
Sydney	° F.	71·6	71·3	69·3	64·7	58·8	54·7	52·7	55·1	59·2	63·6	67·0	70·1	18·9	—
	In.	3·65	4·24	4·97	5·52	5·15	4·78	4·82	2·95	2·82	2·83	2·81	2·83	—	47·37
Brisbane	° F.	77·0	76·5	74·3	70·3	64·4	60·2	58·5	60·5	65·3	69·9	73·5	76·3	18·5	—
	In.	6·50	6·31	5·73	3·69	2·80	2·76	2·26	2·06	2·03	2·57	3·74	4·94	—	45·39
Hobart	° F.	62·1	62·3	59·4	55·2	50·5	47·0	45·7	48·0	51·0	54·0	57·2	60·2	16·6	—
	In.	1·86	1·48	1·69	1·88	1·90	2·23	2·17	1·83	2·10	2·29	2·46	1·98	—	23·87

human comfort, and excessive humidity in warm or hot climates has a very debilitating effect, especially upon Europeans. It should be emphasized, therefore, that Australia, the 'land of sunshine,' has, generally speaking, a dry

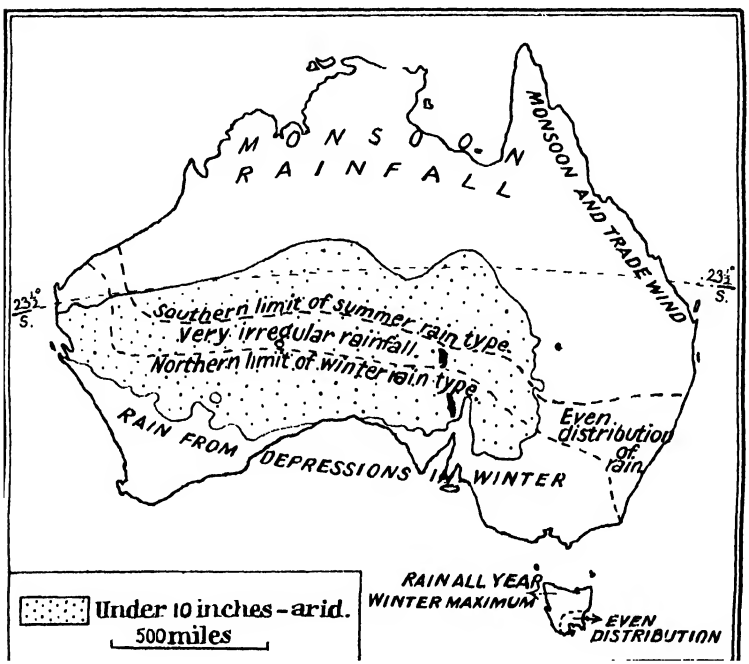

FIG. 31. AUSTRALIA—RAINFALL TYPES

The lines demarcate regions of the summer and winter rain types. Particularly in the south east of the continent there is a spread of winter rain into the summer rain region, and *vice versa*. The winter precipitation is an important factor in wheat-growing.

atmosphere, with summer wet-bulb readings in most parts considerably below and in interior districts far below the dry-bulb readings. The generally dry atmosphere makes the high temperatures much more bearable, but it is of importance that in the northern and north-eastern belt of heavy monsoon rainfall the high summer temperature is associated with high humidity, which militates against, if it does not

actually preclude, white settlement; the winters of this region, however, show a much lower humidity.

The seasonal distribution of rain may be summarized as follows. The northern half of the continent receives summer rain due to the monsoon, but the eastern margins receive in addition appreciable precipitation in winter due to the south-east trade winds. The southern margins receive their chief rainfall in winter; even east of Melbourne there is rather more rain in winter. Over Eastern Victoria and South-east New South Wales, however, is a region where the rainfall is relatively well distributed; this is partly due to elevation and partly to the monsoonal effect in summer and cyclonic movements in winter. Tasmania is again a region of well-distributed rainfall, with a winter maximum over most of the island, from its position in the westerly wind belt.

Mean annual rainfall figures tend to hide certain important facts. Really heavy totals are confined to the northern and eastern parts, and 100 inches is exceeded only in two areas, the eastern margins of Queensland about latitude 17° S. (where Harvey Creek has 165 inches) and the western highlands of Tasmania (where Lake Margaret averages 145 inches), but from the annual rainfall map it would appear at first sight that the northern two-thirds of the continent have a rainfall amply sufficient for agricultural or pastoral pursuits. The reliability and nature of the rainfall, however, bring about serious modifications. Thus the annual rainfall of Harvey Creek has varied from 81 inches in 1902 to 255 inches in 1921. This perhaps may be expected in a region subject to tropical cyclones bringing the heavy thunderstorm rain that characterizes the monsoon, but interior districts show even more striking divergences from the average rainfall. One station in South-west Queensland in a drought year received only 2 inches of rain, while 29 inches were recorded in another year. The drought may be prolonged for several years in succession; thus the summer of 1929–30 brought rain to many interior districts of Southern Queensland and Northern New South Wales that had been practically rainless for the previous four or five years.

The reliability of the rainfall is clearly an important factor

in farming; the stocking of a district must be based mainly upon the minimum rainfall which it may receive. The crop yield will depend largely upon the rainfall, and agricultural returns are bound to vary from season to season. The reliability of the rainfall is greatest (apart from the extreme north of Arnhem Land and the Cape York Peninsula) in the winter rain districts and in the southern half of the Eastern Highlands; it is least in the middle of the continent. The character of the rain even in normal times is another disturbing factor; it is largely of the thunderstorm type, far less useful than the lighter but more prolonged falls which characterize the British climate. Heavy storms, too, lead to soil-removal, especially noteworthy in areas which have been cleared of forest. Another factor of importance is the intense evaporation that takes place. The possible mean annual evaporation from exposed water-surfaces varies from 32 inches at Hobart to 94 inches at Alice Springs, so that it is clear that the effective value of the rainfall where it is moderate or small is seriously reduced.

Snow has been known to fall as far north as 31° S. in both western and eastern districts, but the snowfall has no particular importance except on the highlands in the south-east, where it rests in gullies in the Kosciusko region throughout the year. In conserving water for the Murray river the heavy snowfall of this region is of great significance. Snowstorms are associated with the passage of V-shaped troughs of steep gradient, to which reference has been made. Heavy hailstorms are sometimes experienced in the south and south-east.

One or two other climatic features deserve notice. Besides the tropical hurricanes that visit the Queensland coast (which are even more violently felt by New Caledonia), there occur violent cyclones originating in the neighbourhood of Cambridge Gulf and bringing destructive winds and heavy rain to the pearl-fishing area as they travel south-west. These are known as 'willy-willies,' and when they cross the coast and curve south-east toward the Bight, as they may do, they carry rain to the western interior. They may occur at any time of the year, but are most frequent in spring.

Very different are the 'southerly bursters,' peculiar to the coast of New South Wales south of 30° S., though they may be also felt occasionally in the interior of that state and of Victoria. They generally occur in summer, are most frequent in November, and are preceded by hot weather. Their characteristic is a strong cool or cold wind from the south developed in the rear of a depression after the centre has passed and bringing relief after the high temperatures that have preceded it. The passage of the centre of the trough is often marked by heavy rain. In the interior they are rare in years of good rainfall.

In summer all parts of Australia are subject to hot, desiccating winds from the interior, such as the 'brick-fielders' of Victoria, while occasional hot winds of a *Föhn* character are felt locally along the south-east littoral.

Water-supply

The foregoing discussion of climate makes it plain that the problem of water-supply is a very urgent one if the great area between the well-watered margins and the purely arid central core is to be made permanently useful. It is not intended to deal at this stage with the important irrigation schemes which have been developed, beyond remarking that the headstreams of the Murray and its tributaries, occupying as they do narrow valleys in the well-watered highlands of the south-east, provide special opportunities for the construction of storage dams, and the flat alluvial plains through which the rivers pass offer a big field for the use of the conserved water; outside New South Wales and Victoria irrigation is on a relatively small scale, although Queensland has at least one big scheme. It is, however, desirable to deal here with the physical aspects of the artesian water-supply, which is so important a feature of the stock-rearing industry.

Artesian Water. The existence of underground water in the eastern interior had long been suspected. The occurrence of mound springs along the south-western margins of the Eyre depression was a relatively early discovery, and there

was also the problem of what happened to the enormous quantity of water supplied by the upper streams of the westward-flowing rivers to the plains across which they flow with relative difficulty. Actually the first bore was put down at Sale, in Eastern Victoria, in 1879, in what proved to be a small artesian basin, and in the same year two successful bores were put down in Western New South Wales. These

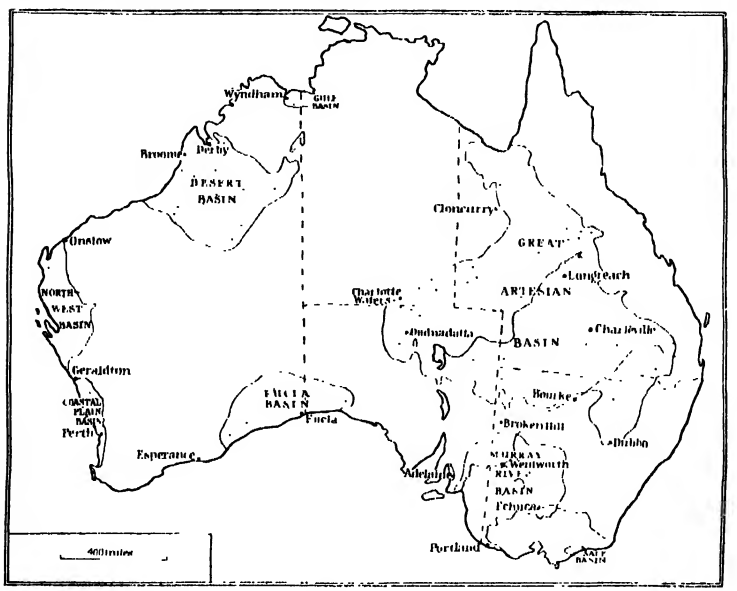

FIG. 32. AUSTRALIA—ARTESIAN BASINS

Various place-names have been inserted to assist in locating the different artesian areas.

were private enterprises, and it needed a serious drought in 1885 to induce the Queensland Government to test the possibility of underground water; in that year a bore sunk to 1663 feet (774 feet below sea-level) yielded 291,000 gallons of flowing water a day. This was the beginning of active boring wherever in the continent the geological structure suggested the existence of underground water.

The theory of the artesian basin assumes the existence of water-bearing beds in a synclinal formation underlaid and

covered by impervious strata except where the upturned beds at the edge of the basin form an outcrop, known as the 'intake.' Such formations cannot be expected where the ancient rocks of the continent crop out, and it is not surprising that the artesian areas—nine basins are known occur in the regions invaded by the sea in Cretaceous and Tertiary times. The prevailing view is that the water sinks into the intake beds, and is forced out, in the case of flowing wells frequently from great depths, by hydrostatic pressure; the water on this view is 'meteoric'—*i.e.*, derived directly from the rainfall or by percolation from rivers.

This view has been strongly contested by Professor J. W. Gregory.[1] While not denying the existence of artesian water of meteoric origin, as in the Coastal Plain Basin of Western Australia, he put forward another theory of the origin of the water in the eastern half of the continent. He rejected the suggestion that the artesian water in the Lake Eyre district could be derived from the Queensland highlands, 600 miles away, pointed out that the friction due to the passage of water through the porous strata would eliminate the hydrostatic head at any considerable distance from the intake beds, referred to anomalies of temperature and pressure in near-by bores, and emphasized the highly mineralized character of much of the artesian water. In his view the water is mainly 'juvenile' ('plutonic' or 'intra-telluric')—that is, derived from ancient igneous rocks which have given up much of their included water in the course of time to the overlying younger strata, from which, when the bores are sunk, the water is forced by the pressure of the dissolved gases or by the pressure of the overlying strata.

The bores show considerable variations. The depth at which artesian water has been struck varies from 10 feet to 6000 feet, and the temperature of the water from 72° F. to 212° F. All the water is impregnated to a greater or lesser degree with mineral salts—mainly sodium carbonate or sodium chloride—and in some cases with sulphuretted hydrogen. The yield of water from different bores varies

[1] In *The Dead Heart of Australia* (1906) and again in the *Geographical Journal* in 1911.

enormously—some have been known to give more than a million gallons a day; in general there has been in recent years an annual decline in yield from the existing wells. This decline may be due to drought and to the use of water accumulated before extensive boring began, but in Professor Gregory's view the decline is only to be expected, and the supply will ultimately fail.

The consensus of expert Australian opinion is against Professor Gregory's theory, but it is probably unwise to assume that all the artesian water is of meteoric origin.

Besides the flowing wells are many so-called 'sub-artesian' wells, in which the water rises, but does not overflow, and

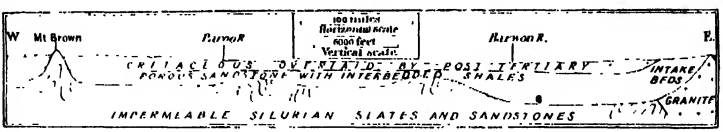

FIG. 33. SECTION ACROSS THE GREAT ARTESIAN BASIN IN NEW SOUTH WALES, BETWEEN LATITUDES 29° S. AND 30° S.

This is a continuation westward of the section shown on p. 62. The intake beds consist of porous sandstone interbedded with shale; the Cretaceous rocks (interbedded shale, limestone, and sandstone) are largely overlaid by post-Tertiary deposits.

Based on a diagram in the "Mineral Resources of New South Wales" (New South Wales Geological Survey)

has to be pumped out. Great importance is now attached to the control of the flowing wells, so that the water does not run to waste.

The total number in 1927–28 of artesian and sub-artesian bores yielding supplies of water was 4732; of these 3260 were in Queensland.

The Artesian Basins. Nine artesian basins of varying importance are found. The *Great Artesian Basin* covers over 600,000 square miles, of which area rather more than half is in Queensland, with large areas in Northern New South Wales and North-east South Australia and a comparatively small area in South-east Northern Territory. The floor of the water-bearing Lower Cretaceous beds is irregular, but they dip in the north toward the Gulf of Carpentaria, and are bordered on the south by a barrier of Primary rock. The wells show wide variations of depth, pressure, temperature,

and salinity, and some are impregnated with sulphuretted hydrogen, carburetted hydrogen, or carbon dioxide. On the edge of the Eyre depression hot water oozes out at the mound springs. This basin is by far the most important.

The *Murray River Basin*, in which the water-bearing beds are of Tertiary age, has wells which are mostly sub-artesian, and many are of little or no value owing to excessive salinity. This basin supplies the Lower Murray with some of its water, springs being found on the banks at low water. The *Sale Basin*, at the eastern end of the Great Valley of Victoria, yields water much of which is highly mineralized; fortunately this region has a rainfall making it relatively independent of artesian water. The *Adelaide Plains Basin*, though small, gives a considerable supply of excellent water, but the *Eucla Basin*, in which Tertiary and recent deposits dip toward the Bight, yields saline water, useful, however, for sheep. The *Coastal Plain Basin* gives mainly fresh water, which becomes brackish in the northern part. There is a considerable number of bores in the pastoral country of the *North-west* or *Carnarvon Basin*, while the absence of any considerable settlement in the *Desert* or *Broome Basin* accounts for the small total of a dozen bores in this area. Finally, the *Gulf Basin* is of substantial value in a stock-rearing area, but seems susceptible of further development, as its extent is not fully known.

Water-power. The *régime* of the rivers even in the relatively well-watered east militates against their use for hydro-electric purposes, and there is only slight development in this direction. It is estimated, however, that about a million horse-power might be made available. Tasmania offers obvious possibilities in this connexion, and a big scheme has been developed in the middle of the island; nearly half a million horse-power can be called upon. Hydro-electric enterprises in connexion with water-storage for irrigation are referred to later.

VEGETATION

The division of Australia into conventional climatic regions gives a clue to the distribution of forest, grassland,

and semi-desert and desert. The well-watered margins possess natural forests, distributed in widely varying proportions among the different states. Thus nearly two-thirds of Tasmania is forested, one-fifth of Victoria, one-tenth of Queensland, but less than 1 per cent. of South Australia. The

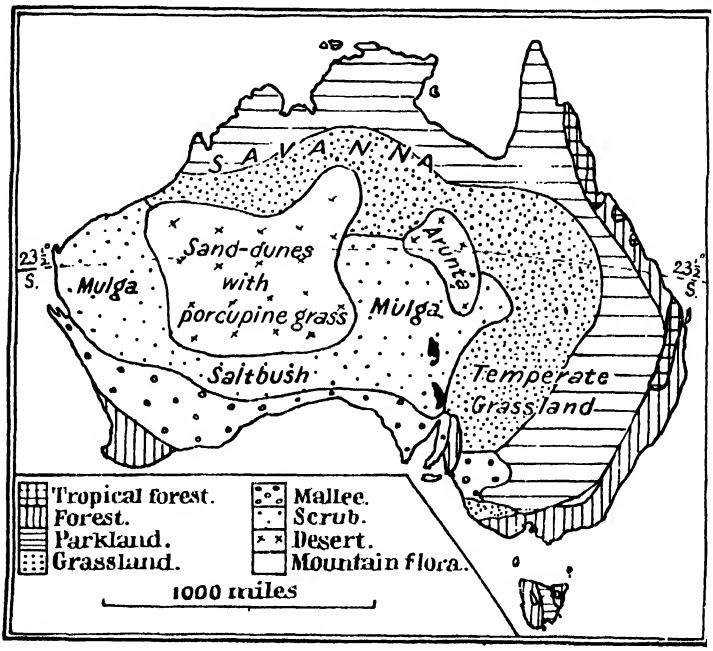

FIG. 34. AUSTRALIA—NATURAL VEGETATION

Compare the areas of desert and scrub land with the regio closed by the 10-inch annual isohyet.

Based on Griffith Taylor and A. V. G. James

indigenous trees, however, are evergreen and mostly adapted to drought, so that they penetrate along the water-courses, and in stunted forms into the interior grasslands possessing a long dry season. This tree-growth in the grasslands may be scattered, or it may densely cover large areas, as, for example, in the scrub of North-west Victoria. The grasslands, though commonly classified as tropical (savanna) and temperate (steppe), do not widely differ, except that there

is generally more tree-growth in the savanna areas; in them are also found some species of xerophilous plants such as prevail in the semi-desert.

The characteristic vegetation reflects the long isolation of the continent from the rest of the world. Except for the intrusive vegetation of the north-east, derived from the relatively recent connexion with New Guinea, the bulk of the flora is typically Australasian, although there are types which are found in Africa (including a relative of the baobab) and in South America (including varieties of the araucaria conifers).

The characteristic trees of the extra-tropical region are eucalypts (gum-trees) and acacias (wattles). The eucalypts are quick-growing, hardwood trees, some of which are of giant size and of great age, as in Gippsland and the south-west, and the gum forests possess a characteristic fragrance due to the oil which is commercially expressed from some varieties. They are flowering trees, but as the leaves tend to turn edgewise to the sun they throw comparatively little shade. There are 350 species. Two-thirds of the world's known varieties of acacia, numbering over 750, are found in Australia, and the sweet-scented yellow blossom has become the national emblem. The wattle is quick-growing, but usually has a short life, as it is subject to insect pests. The existing types of gums and wattles are generally of great antiquity, and exhibit striking adaptations to the climatic conditions.

The so-called 'brush forests' (jungle forests) of the hot, wet margins of Queensland are similar in type to the forests of the New Guinea lowlands; they are characterized by lianas and softwoods, and appear to have largely exterminated the indigenous flora; they are limited on the west by deficient rainfall. But this intrusive vegetation is not found on the north-west coast, though it stretches into the north of New South Wales. Ferns are very characteristic of the wet eastern coastal margins, especially in the sheltered gullies, the ferns varying from the delicate maidenhair to handsome tree-ferns of considerable size. The undergrowth is often luxuriant where the rainfall is heavy. Conifers are

well represented in some parts, and include in Queensland the red cedar, kauri pine, and varieties of araucaria, while in West and South-west Tasmania occur important forests of Huon pine and King William pine. Speaking generally, forests are confined to the wetter coast margins and highlands, but the plateau areas of the Eastern Highlands are

FIG. 35. TROPICAL VEGETATION—HOT, WET FOREST
Duak Island, North Queensland.
By courtesy of the Immigration Office, Commonwealth of Australia

generally open country, and there is little real timbered land west of the Dividing Range. Even Northern Territory, despite its monsoon rainfall, exhibits little forest except along the rivers.

It is worthy of note that the names attached to many trees, especially those of economic value, are somewhat misleading. Thus ironbark, tallowwood, blackbutt, white mahogany, red mahogany, grey box, mountain ash, stringy bark, and silver top are all eucalypts, as are the jarrah, karri, and tuart of the

south-west corner. Besides acacias and conifers, the non-eucalypts include sandalwood, of some importance in the sub-arid region of Western Australia. Ruthless burning off of forests took place in the early days of settlement, and forest fires are frequently destructive to-day, but forestry has become an important Government interest in recent years, and reafforestation is becoming steadily more prevalent.

FIG. 30. STANTHORPE, SOUTH QUEENSLAND

On the southern margin of the Darling Downs. Rolling plateau country typical of the Eastern Highlands, with a good deal of timber.

By courtesy of the Immigration Office, Commonwealth of Australia

Inside the belt of well-timbered country of the east coast there is much grassland of a park-like character covering the plateau areas and stretching toward the arid region. The tree-growth is chiefly eucalypt in character where the rainfall is heavier, but acacia prevails with increasing aridity, and there are areas of brigalow scrub (brigalow is a dwarf acacia) in Queensland and much larger areas of mulga scrub (also acacia) in the drier parts of the savanna and temperate grassland. The drier parts of the southern margins from the Wimmera plains of North-west Victoria across the Nullarbor

Plain is largely mallee country, mallee being a stunted eucalypt exhibiting a bunchy growth. The wattles often show remarkable adaptation to drought, sometimes covering their leaves with resin (a protection against extremes of temperature as well as against drought) and sometimes suppressing the leaf altogether.

Arid Australia is characterized by a large central area of sand-ridge desert with mulga scrub to the west and saltbush and mulga to the east, in the Eyre basin. Although these areas may present a wonderful prospect of grass, herbs, and flowers after rain, the 'gibber' plains and loam plains of the Eyre basin are without vegetation over large tracts for years at a time. The saltbush is characterized by mulga thickets and low, fleshy plants adapted to a saline soil, while spinifex, a coarse, hard, spiny grass growing in tussocks three to four feet high, is found in large areas of the bush country. The sand-ridge desert is marked by scattered growth of mulga and porcupine grass so tough that even the camel rejects it.

Some reference is desirable to the thistle, an introduction which has become something of a nuisance, and to the prickly pear, another introduction which has become a menace in parts of Queensland and New South Wales. The latter is estimated now to cover some 70,000 square miles. It has encroached upon previously farmed land, and successful effort is being directed toward its control by the introduction of an insect parasite.[1]

While Australia possesses large areas of grass and other fodder plants (though there has been considerable planting of European grasses in the more settled areas), its cereals and plants yielding human food have almost exclusively been introduced. The native food plants are insignificant; a few yam-like roots in the wetter parts, the foliage or seeds of some plants of more general distribution, and a number of

[1] The Annual Report for 1930 of the Prickly Pear Land Commission (Queensland) states: "The work accomplished by the various pear-destroying insects, particularly the Cactoblastis grub, has been remarkable. . . . The prickly pear pest has now been controlled, and each year will witness a substantial decrease in the area of the state subject to this appalling infestation." A warning is added as to the need for further work and continued vigilance.

fruits, including some of the lime family in Queensland, sufficiently indicate their importance.

Animal Life

If the flora of Australia illustrates the development of ancient types in isolation, this is even more marked in the fauna. The continent is markedly poor in mammals of orders higher than the Marsupialia, an order long since extinct elsewhere, except for a few types surviving in the Americas as far north as the southern part of the United States. Indeed, egg-laying mammals, notably the duck-billed platypus and the spiny ant-eater, are confined to Papua, Australia, and Tasmania, the former, however, not being found in tropical latitudes. While the female of most species of Marsupialia carries her young in a pouch, this is not always the case, and it is certain features of the skeletal structure which particularly distinguish the order; the arrangement of teeth is also very characteristic, especially as distinguishing the carnivorous from the vegetarian marsupials. The kangaroo family has members varying from only ten inches long to those taller than a man, the smaller varieties being found in the scrub-lands. Many marsupials resemble animals familiar in other parts of the world; thus there are types resembling the cat, such as the Tasmanian devil and the Tasmanian wolf; there are opossums, flying squirrels, and the koala, or native bear, all of which belong to the marsupial family. Apart from certain bats and rats and the dingo, there are few mammals higher than this in the evolutionary scale.

Although there is an absence of large wild animals, the dingo, or Australian dog, is of sufficient importance to deserve special mention. It is found all over the mainland, is similar in appearance to a large collie dog, but, being of a very savage nature, is hardly susceptible of domestication, though the aboriginals were able to train the young ones. The dingo hunts at night, and makes great inroads upon sheep in the remote districts. Despite the continuous warfare against him and the price on his head, the dingo appears to be increasing.

The bird life is very varied. Most characteristic, perhaps, are the running birds, the cassowary (found in the northern parts), and the emu (found all over the continent). There are numerous species of pigeons, as well as of brightly coloured parrots. Among the beautiful and curious birds are the bird of Paradise of the northern parts, the lyre-birds of the fern gullies of the east, the cockatoos (found only in this continent), the laughing jackass (a kingfisher), the bower bird, the honey-eater, the egret, and the mallee hen.

Among reptiles, the estuary crocodile and the turtles of the northern coasts and the numerous species of lizard, including the goanna or monitor, represent an intrusive fauna from the north. Although there are 115 species of snake (of which Tasmania has only four), more than half of which are venomous, only five species are really dangerous.

The *régime* of the rivers militates against any richness of fresh-water fish; some survive drought by burying themselves in mud. A curiosity of Eastern Queensland rivers is the lung fish, one of three surviving species of a type that had world-wide distribution in earlier geological times. Edible fish are plentiful in the surrounding seas, where the shark abounds; it tends, however, to avoid the cooler southern waters. Among varieties of fish of economic importance are the pearl oyster of the warmer waters and the trepang, or *bêche-de-mer*, specially abundant off the Queensland coast.

The absence of indigenous domestic animals and of large carnivores facilitated the introduction of ordinary animals of use to man, while the worst insect-borne diseases that affect both man and beast in similar latitudes in Africa are absent. Mosquito-borne diseases are stated to be absent in New South Wales, Victoria, South Australia, and the southern part of Western Australia, but malaria is experienced in the tropical north, where hookworm (not borne by mosquitos) has been met with along the warmer eastern margins. The white ant is widespread on the mainland, and few timbers resting in water resist the teredo-borers.

An introduced animal of importance is the rabbit, which has spread over the continent, and, despite the slaughter of many millions each year by human and other enemies,

flourishes, and consumes much of the best grass and millions of seedlings, besides disturbing the surface soil and thus hindering growth. Could it be exterminated, the country could support many more stock.

Some of the native animals—for example, the burrowing wombat—attack crops, and the fruit-trees may be troubled by birds.

Minerals

Only the briefest reference to mineral wealth will be made at this stage. The ancient rocks, with large and numerous igneous intrusions, are inevitably rich in metallic ores (though these are frequently not very accessible, even in regions where they are known to exist), and provide plentiful building-stone. Coal and lignite both occur, though their distribution is limited; the total resources are not very considerable, having regard to the area of the continent.

CHAPTER III

AUSTRALIA: EXPLORATION, SETTLEMENT, AND DEVELOPMENT

THE main facts relating to the discovery of Australia have been outlined in an earlier chapter.[1] Though the honour lies with the Dutch, their neglect, even after Tasman's discoveries of 1642–44, to follow it up (which arose from their concentration on the lucrative East Indian trade and the discouraging reports brought back by those who first touched these new lands) eventually resulted in the destinies of the continent being placed in British hands. Captain Cook had in 1770 taken possession in the name of Britain of the coast which he had charted, and Captain Phillip commanded the eleven vessels that were to make the first settlement. The fleet was sent by Pitt's Government to establish the settlement at Botany Bay, which Captain Cook had commended as an ideal spot for such an enterprise. The fleet arrived in January 1788, carrying 700 convicts and 300 soldiers.

Cook had been mistaken about Botany Bay; it was too shallow for the ships, and provided unsuitable land for settlement. The expedition moved farther north, to a harbour in which "a thousand ships of the line might ride securely," and Sydney, or Port Jackson, was founded.

Such was the somewhat inauspicious start of Australian development.

THE BEGINNINGS OF SETTLEMENT

The early settlement met with many difficulties, some connected with its penal character and others with the difficulty of obtaining food and other supplies owing to its

[1] There is a very full discussion in *The Discovery of Australia*, by G. Arnold Wood (1922).

remote position. Farming was immediately begun, some good land being discovered at Parramatta, a few miles to the west of Sydney. Free immigrants arrived in 1793, but for a quarter of a century settlement did not develop beyond a small area stretching some seventy miles north and south

FIG. 37. THE NEPEAN GORGE, NEW SOUTH WALES

Cut by the river during the elevation of the Blue Plateau. The escarpment with its difficult gorges long confined settlement to the coastal district.

By courtesy of the Immigration Office, Commonwealth of Australia

of Sydney, and at most fifty miles wide. The Blue Mountains, with their deep ravines, proved an insurmountable barrier until Gregory Blaxland and others reached the plateau in 1813; the Upper Macquarie was found, and a few years later Lake George, the Goulburn Plains, and the Liverpool Downs were added to the known tracts. Meanwhile, in 1798, George Bass worked southward along the coast, passed Ninety-mile Beach, reached Western Port, and, noticing the strong swell from the south-west, returned to

Sydney suspecting that Tasmania was not joined to the mainland. Next year, with Matthew Flinders, he circumnavigated Tasmania, and the latter later worked along the south coast of the continent. These discoveries were followed by the establishment of a settlement—which failed—at Port Phillip, and, in 1804, the foundation of Hobart. By 1815 a substantial area round Sydney was known and the relatively easy route between Hobart and Launceston had been traversed.

It is of interest to note that Captain Phillip sailed by the Cape route, and was taken across the Indian Ocean by the west wind to Tasmania, the south of which he skirted. This new route into the Pacific was taken up by New England traders, as well as by East Indiamen, and the first trading vessel to reach Sydney was the *Philadelphia*, in 1792. By 1819 the worst difficulties of the New South Wales colony had been overcome; the population included not only convicts and soldiers, but ex-convicts (many of whom had been transported for reasons that nowadays would be regarded trivial), as well as numbers of free immigrants, who were henceforward to dominate the colonization;[1] a trade, albeit small, including wool and even coal, had been built up; and the expeditions into the interior had inaugurated a period of substantial development.

Though New South Wales became a Crown colony in 1824, transportation to it continued. Penal settlements were made at Macquarie Harbour, in Tasmania, in 1821, and in 1824 at Moreton Bay, where the Brisbane river had been discovered a year earlier. In 1827 a military post was installed at Albany, on King George Sound, followed by the foundation of Perth, on the Swan river, two years later; and when a settlement was made at Adelaide in 1836 a beginning had been made in each of the regions that was subsequently to form a state. The penal settlement at Albany, as well as one on Melville Island, off Northern Territory, in 1824, was founded largely through fear of possible French attempts to establish themselves in Australia. It is noteworthy that

[1] In 1819 there were 27,294 inhabitants, of whom about 40 per cent. were convicts, 25 per cent. ex-convicts, and 5 per cent. free immigrants.

settlement in Victoria, the most temperate of all the mainland states, was relatively late. An expedition from Sydney had crossed the Victorian highlands in 1824, prior to which whalers and sealers had visited the shores for a good many years, but the first permanent settlement was not made until 1834; it was at Portland Bay. Settlement at Port Phillip began in 1836, after Sir Thomas Mitchell had traversed Victoria and described it as Australia Felix, to distinguish it from the parched interior.

Exploration

The Discovery of the Murray-Darling System. The work of opening up the interior is associated with a number of important names. In 1816 Lieutenant Oxley followed the Lachlan until he found it ending in swamps. This raised in an acute form the problem of where the inland-running rivers went. Was there an inland sea beyond the highlands or was there a big river-system? Hamilton Hume and William Lovell in 1824, working south-west from Sydney over the Goulburn Plains, crossed a river—the Murray at what is now Albury, and reached Port Phillip. Charles Sturt, between 1824 and 1830, solved the problem of the west-flowing rivers, the upper streams of most of which had already been found. In 1828 he sought for Oxley's marshes, which had, however, been dried up by two years' drought, and, pushing westward, reached a broad river, which he named the Darling, then returning to Sydney. Later he went down the Murrumbidgee, reached the main river (calling it the Murray), found a right-bank tributary which he suspected was the Darling he had previously discovered, and finally reached Lake Alexandrina. A few years later the Victorian tributaries of the Murray were investigated by Sir Thomas Mitchell, and in 1840 Count Strzelecki discovered Mount Kosciusko.

The Unveiling of Queensland. Allan Cunningham in 1823 had reached the Liverpool Downs from the Upper Hunter, and four years later, continuing northward from the same region, he crossed upper tributaries of the Darling that rise in the New England Range, and discovered the Darling

Downs, reaching Moreton Bay (Brisbane) by what is known as Cunningham's Gap. These discoveries opened up much useful land. In 1844–45 another botanist, Ludwig Leichhardt, travelling north-westward from the same region, crossed the Burdekin and other rivers, skirted the southern coast of the Gulf of Carpentaria, and reached the northern part of Arnhem Land. Another important journey was that of A. C. Gregory, who in 1856 worked eastward through Northern Territory from the Victoria river, and reached Brisbane by way of the Gilbert and Burdekin rivers. It was not, however, until the third quarter of the century that much of Queensland was reasonably well known.

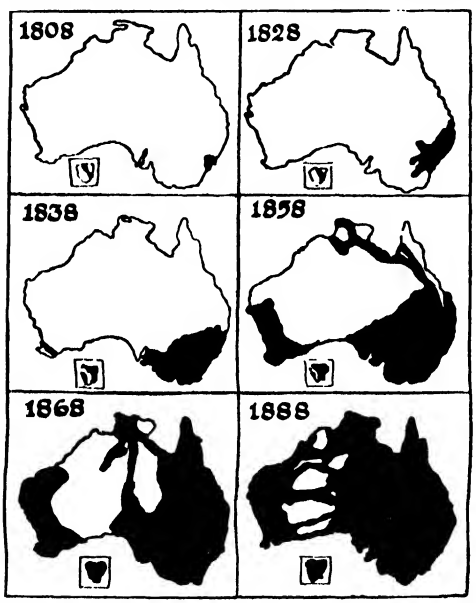

FIG. 38. PROGRESS OF AUSTRALIAN EXPLORATION

The Penetration of Arid Australia. Edward Eyre in 1840 forced his way through 500 miles of arid country north of Adelaide, finding the salt lakes Torrens and Eyre and much stony desert in what is now known to be the driest part of the continent, but failing to find the pastures which were the object of his search. Before reaching Adelaide on his journey back he struck westward in 1841, and, after suffering great hardships in following the Bight coast, eventually reached Albany. Somewhat later Sturt conducted an expedition from the Darling north-westward into the region north of Lake Eyre, but was forced to turn back. In 1860 John

McDouall Stuart, who had accompanied Sturt, attempted to cross the continent from Adelaide, but could not get far beyond the Macdonnell Range; two years later he achieved his object, traversing what is now the route of the Overland Telegraph. While this successful expedition was in progress, Robert Burke and William Wills crossed from Melbourne nearly to the Gulf of Carpentaria, only to die of starvation in the bush country round Cooper's Creek on the return journey.

Western Australia. After Captain Fremantle landed at the Swan mouth in 1829 a good deal of coastal exploration was carried on, as well as exploration in the immediate hinterland. Between 1857 and 1861 Frank Gregory explored much of the region between the Murchison and De Grey rivers, while Henry Lefroy in 1863 penetrated to the Coolgardie area. Six years later Lake Barlee was reached by John Forrest, who in 1874 worked from Geraldton eastward through the spinifex region to the Overland Telegraph, later visiting the Kimberley area. When Ernest Giles had made two journeys in 1875, one along parallel 30° S. and the other about latitude 24° S., the extent and character of the arid western plateau could be generally recognized. It was not, however, until the end of the century that much of the interior was penetrated.

The Results of Exploration. Many other names figure in the splendid record of Australian discovery—too many even to mention here. The knowledge obtained by the series of explorations outlined above had two important aspects. On the one hand it showed the immense resources of the continent, especially in pastoral areas; on the other it showed the limitations imposed by aridity, besides disclosing the variations in value of districts of marginal rainfall as indicated by reports of the same areas brought back by explorers who visited them in different seasons. Almost invariably accounts of favourable areas were followed up by pastoralists; thus A. C. Gregory's description of good grazing-ground round the Burdekin was followed by immediate occupation. Early reports of gold and other mineral wealth resulted in considerable local additions to topographical knowledge through the activities of prospectors; in this way pastoralists' reports of copper in the Yorke Peninsula and to the north led to the

opening of mines. Exploration was seldom hindered by trouble with the aboriginal inhabitants.

The Aboriginals

The scanty aboriginal population led to the development of Australia as a 'white man's country' without the complication of the difficult native problems that mark white settlement in similar latitudes in Africa. All figures regarding the native population are necessarily estimates; it is thought that at the time of discovery the number was about 251,000, but with the advance of white settlement the natives either retreated or died out—whole tribes succumbed -and to-day the aboriginals (including half-castes) are estimated to number only about 75,000, of whom some 60,000 are full-bloods. In 1925 only 66 full-blood aboriginals were recorded in Victoria, New South Wales having about 1000. The greatest numbers are in Queensland, Northern Territory, and Western Australia, chiefly in areas where white settlement is not seriously established; South Australia, being largely arid, has relatively few. Tasmanian aboriginals, after being all but exterminated, died out in the seventies of last century.

The aboriginal represents a type different from that prevailing in any region adjacent to Australia. He has been described as primitive, though not degraded. The major physical characteristics show a Caucasian type, allied probably to the pre-Dravidians of Southern India. He appears to have entered the continent in the north-west, and to have migrated from there into the other parts. The aboriginal is long-headed; the hair is generally wavy (never woolly), and of oval section. The forehead is low and flat, the skin colour varies from chocolate brown to a dark copper colour, and the eyes, dark brown or reddish-hazel, are deeply set. Other physical characteristics include the growth of plentiful hair on the face, a wide nostril, high cheek-bones, an overhanging brow, and a loose big toe with which things can be picked up. Some very fine tribes, the members of which are tall, strong, and vigorous, are found in the north-west of the continent.

Though the aboriginal is sometimes said to be fierce and

bloodthirsty, this description is in general hardly borne out by experience. He is observant and self-reliant, and inevitably a wanderer; he cannot accommodate himself to settled life; though children are often quite intelligent as pupils, sooner or later the longing to 'go bush' gets the better of them, and the aboriginal becomes sick if he continues at regular work; he has proved very capable as horseman and

FIG. 39. ABORIGINALS FIND A TURTLE'S NEST
Note the belt and shorts.
By courtesy of the Immigration Office, Commonwealth of Australia

stockman. He is a wandering hunter and gatherer, observant and patient as a tracker, and shows considerable ingenuity in his weapons and implements. The returning boomerang is in general a toy; a heavy one is used for serious work. The spear is universal, but the bow and arrow appears to be known only in Queensland. His fishing methods include the use of hooks, harpoons, baskets, cages, nets, weirs, and dams. His varied food includes, besides fish, animals from frogs and lizards to kangaroos, honey, and seeds (such as the nardoo seeds upon which Burke and Wills tried to maintain them-

selves). The women gather and prepare food (some of which requires careful treatment, owing to its poisonous properties) and make nets and bags. Huts are made of bark (of which some gum-trees supply large slabs), boughs, and bushes. In arid regions some roots, particularly the gum-scrub, yield water.

The social organization is purely tribal; the tribes are usually small, with complex but distinctive social codes. Religious belief is at the level of magic and sorcery, and the initiation ceremonies and corroborees, or ceremonial dances, are frequently elaborate. The language is lacking in a number of our sounds, notably the sibilants.

The future of the aboriginal is obscure. He hardly survives in the settled areas, takes practically no share in the characteristic occupations of the whites, and has little power of resistance to European diseases. It is possible that a policy of native reserves may ultimately be followed. The aboriginal will doubtless remain for a long time in the unsettled areas, on the margins of which he occasionally figures as a cattle-thief.[1]

The extinct Tasmanians were of a more negroid type, and probably representatives of the original stock from which the Australian aboriginals sprang before later admixture.

Development

The development of Australia could not be based upon penal settlements. In New South Wales, for example, efforts were made to develop the colony on the basis of convict labour, either directly or by assigning convicts to free settlers. Under Governor Macquarie (1809–21) such labour was usefully employed in building roads and bridges; in particular a road was opened from Sydney to Bathurst. But it was the free settlers upon whom devolved the expansion of the colony's resources, a definite bent to which had been given as early as 1805, when Captain John Macarthur established the first considerable sheep-farm. Arable and pastoral

[1] See *Wanderings in Wild Australia* (2 vols., 1928), by Sir Baldwin Spencer, F.R.S., for a sympathetic account of the aboriginal.

farming was, of course, the primary preoccupation of the colonists, but sealing, whaling, and lumbering were all carried on. Coal was worked from an early date, and other minerals were in the middle of the nineteenth century to play a large part in the fortunes of the new colonies.

Progress of the Settlements. New South Wales had at first no inland boundary, and included the eastern half of the mainland, as well as Tasmania; in 1825, when Tasmania was separated from it, its western boundary was fixed as longitude 129° E.; at this date it had about 40,000 inhabitants. Transportation to New South Wales virtually ceased in 1840, to be finally abolished in 1850, the year that saw the commencement of the first Australian railway. The cessation of transportation in 1840 was a financial blow, but some improvement came with the introduction of the industry of producing tallow by the boiling-down process. By 1849 the trade in tallow was more valuable than that in whale oil had ever been. Tasmania (Van Diemen's Land) commenced as a penal colony, and escaped convicts and other outlaws for a time terrorized both the aboriginals and the free settlers. In 1830 there were 24,000 inhabitants, a number nearly trebled when transportation was abolished in 1853.

Western Australia early suffered from a boom that attracted colonists to the Swan river area, colonists who could make little headway owing to the poor character of the land upon which they settled. By 1849 the population numbered fewer than 6000, and the colony, so poor seemed its prospects, even petitioned for convicts to be sent out; transportation went on until the last convict ship arrived in Australia in 1868, by which time better land had been found. The slow progress is indicated by a population at that time of only 20,000.

South Australia had a similar experience owing to a grandiose scheme outlined by Edward Gibbon Wakefield. In 1836 two shiploads of colonists, finding Kangaroo Island unsuitable, settled on the plains at the foot of the Lofty Range. The land needed hard preparation, disputes arose, and the colony went bankrupt. Good government and the discovery of copper pulled the colony round in the forties,

and by 1850 it had 63,000 inhabitants. Stuart's journey of 1861 led to the extension of South Australia's boundary to the north coast.

Queensland's penal settlement, established on Moreton Bay in 1824, long remained isolated. The discovery of the Darling Downs was followed by extensive 'squatting.' Settlement spread, despite the hostility of natives in the north, and the separation from New South Wales was effected in 1859, when the population numbered about 28,000.

Victoria made a late start, and its first settlement was made by enterprising colonists from Tasmania. Good land was found on the banks of the Yarra, and Melbourne, consisting of a few huts in 1835, had a population of 6000 in 1840. Australia Felix did not look back, and secured separation from New South Wales in 1851, when it had a population of 77,000.

A feature of the early development of both Victoria and South Australia was the migration of 'overlanders' from New South Wales. These were drovers who brought sheep and cattle to the new settlements, and so helped to build up the pastoral industry.

The Importance of Gold. Coal, iron, lead, copper, silver, and gold were all known before 1851. With the exception of copper, they had little importance. Copper was worked on a considerable scale in South Australia after its discovery there in 1844, and contributed largely to the growth of that territory. In 1849 a number of Australians took part in the gold-rush to California; some hurried back, in company with immigrants from all over the world, on hearing of the discovery in 1851 by Edward Hargreaves (who had taken part in the Californian gold-rush) of gold on his old farm some twenty miles north of Bathurst. This discovery was quickly followed by further finds near Melbourne and at Bathurst and Bendigo. But for the Victorian discoveries that territory would have lost many of her people to New South Wales; the effect upon South Australia was temporarily disastrous, for nearly 50,000 men left for the new goldfields, and the rising agricultural and copper production suffered a set-back. Victoria was at first the biggest producer of gold, but there

were finds in all areas, though those in Queensland and Western Australia did not become important for many years. The population of the continent, chiefly located in the south-east, rose from 405,000 in 1850 to 1,145,000 in 1860, and if farming received a temporary reverse, it was bound to forge ahead as a result of this great increase.

The gold production from alluvial diggings was usually precarious, and large-scale mechanical treatment of the gold-bearing rocks was involved in the developments that later took place at Mount Morgan (where gold was discovered in 1882) and Gympie, in Queensland, and in the Coolgardie and other goldfields of Western Australia (after 1885); this was also true of the Ballarat and Bendigo fields, in Victoria.

Immigration. The thrifty, hard-working Chinese who were attracted to the gold-diggings roused the resentment of the whites. It was this that raised in an acute form the question of the character of the civilization that Australia was to build up. It is true that the Chinese problem lessened as the diggings were worked out, but it was many years before the 'white Australia' policy received legislative support.

The isolation of Australia and its distance from Europe, especially in the days of sailing-ships, when a five or six months' voyage was common, precluded rapid colonization, as also did the penal character of the early settlements. Assisted immigration to New South Wales was first adopted in 1831, and after Queensland's separation that colony subsidized immigration for many years. In recent years many schemes involving assistance to British immigrants have been adopted in order to ensure a steady growth of the Australian civilization on a white and essentially British basis. The problem is by no means easy; Australia is still largely empty; near by are the densely populated monsoon lands; the white immigrant needs certain qualifications, including something of the pioneer spirit, if he is to fit into a scheme of steady Australian development.

The net immigration—*i.e.*, the balance of arrivals over departures—has varied considerably. As has been noted, the Californian gold-rush took people away, and the Australian gold-discoveries brought in many thousands, but

many left again in 1861, when gold was found in New Zealand. The period of the Great War not only caused a great cessation of immigration, but Australia's War effort saw the loss of nearly 60,000, who died on various War fronts. The net immigration was over half a million in the period 1871–90, but the next twenty years yielded only 66,000. The capacity to absorb and to retain people necessarily depends upon a number of factors, particularly upon the value of the primary production, which is itself largely dependent upon the seasonal rainfall. For some years following the close of the Great War there was considerable immigration, averaging a net annual increment of some 40,000 people, but more recently economic difficulties have led to a great decline in the number of arrivals.[1]

The Increase of Population. Australia is unlikely ever again to multiply its population at the rate at which it increased in the decade 1850-60. The increase will mainly depend, while the 'white' policy is pursued (and this seems a permanent policy), upon the natural excess of births over deaths, although no doubt a steady immigration will be maintained for a long time. In this connexion it may be noted that although the birth-rate is not high (about 20 per 1000 of the population), the death-rate is one of the lowest in the world — under 10 per 1000. It should be remembered that throughout the early period of settlement males enormously outnumbered females; they show a slight excess even to-day. The natural increase of population has in recent years been responsible for an annual increase of about 70,000.

'White Australia.' The abolition of transportation to New South Wales led to the first serious attempts to introduce coloured labour; natives from the New Hebrides were brought in, but the conditions were too difficult for them. Encouragement given by the Queensland Government in the sixties to the cultivation of cotton and sugar led to the importation from the South Sea islands of labourers (known as Kanakas), whose condition was in many aspects for a long time little removed from that of slavery. By 1880 there were

[1] Early figures for 1930 showed an excess of emigration over immigration, but this may be regarded as a purely temporary state of affairs.

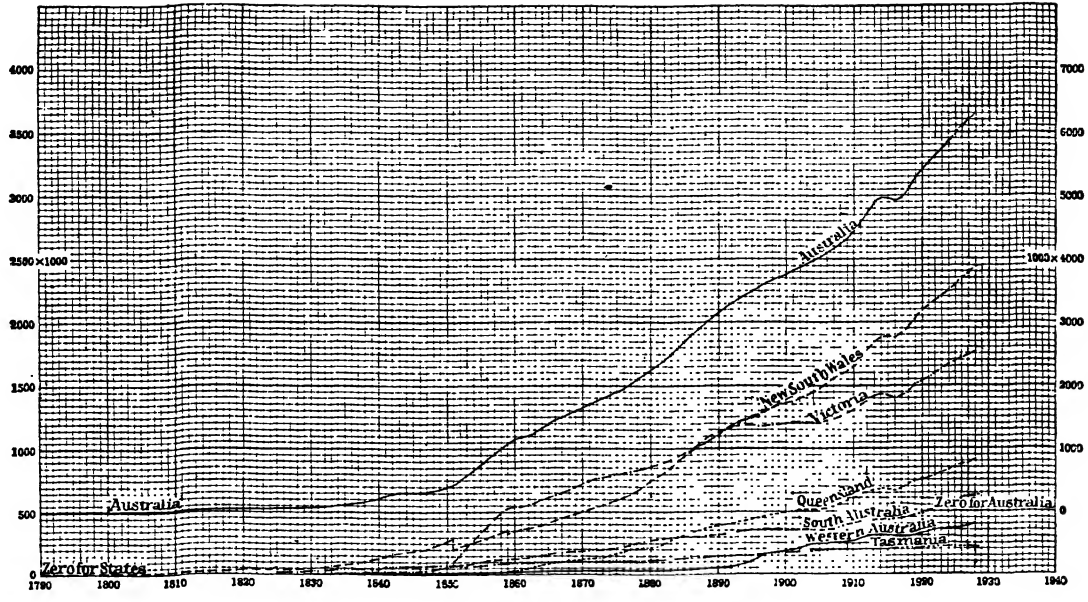

FIG. 40. THE GROWTH OF POPULATION IN AUSTRALIA

The scale for the individual states is on the left (each division, 50,000 persons) and for the continent on the right (each division, 100,000 persons). Zero for the states and for Australia are at different levels. Note the steep rise following the gold discoveries of the middle of last century and the effect of the Great War. The drop in the population of New South Wales in 1851 was due to the creation of Victoria, previously included in the former state. The relatively stationary population of Tasmania is well brought out.

Commonwealth "Year-book"

over 10,000 of them, and Government attempts to regularize the trade had already been made. As the sugar industry was built up on this labour, its prohibition awaited the formulation of a national policy.

Other coloured immigration, apart from the influx of Chinese in the goldfields, was relatively small. The north coast, with its pearl-fisheries, depended upon imported Asiatic labour, and even Afghans appeared in small numbers in connexion with camel transport. But the Australians, keenly aware of their empty territories and isolated position, as well as of their standard of civilized life, set before themselves the achievement of 'white Australia,' and it was this problem which materially contributed to the demand for federation and a uniform policy. The existing law governing coloured immigration dates, apart from subsequent amendments, from 1901. Recruitment of Kanakas was abolished and the repatriation of labourers provided for; all non-Europeans (other than temporary visitors) desirous of entering Australia became liable to a fifty-word dictation test. Thus there is no direct prohibition of coloured immigrants —such a prohibition would have raised difficulties over coloured British subjects—but the law is effective. At the 1921 census the total number of non-Europeans, apart from full-blood aboriginals, was only 48,500; this figure includes all half-castes. Apart from the half-caste aboriginals, the great majority are of Asiatic origin. Many Chinese fill useful *rôles* as cooks, launderers, and market-gardeners.

This policy necessitated drastic Government support for the sugar industry, and raised in acute form the question of the development of the northern margins, which, at present empty, are potentially productive. In recent years, also, much concern has been shown at the arrival of Italians, Greeks, and others of a relatively lower standard of living, and quota arrangements have been put into operation permitting only a small proportion of these immigrants.

Density of Population. The last census, taken in 1921, showed a total population, excluding aboriginals, of 5,435,734. It is estimated at the present time (1931) to be nearly 6,500,000, giving an average density of just over two persons

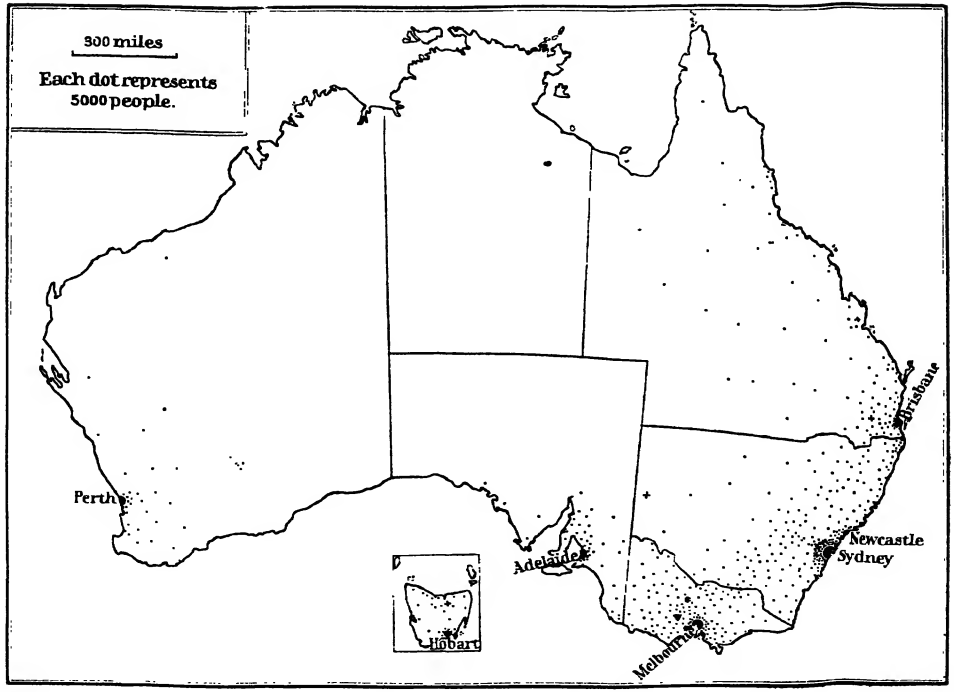

FIG. 41. AUSTRALIA—DISTRIBUTION OF POPULATION (1921 CENSUS)

per square mile. It is hardly necessary, having regard to the very obvious control exercised by climate and water-supply, to discuss in detail the reasons why, outside the urbanized areas, the population should necessarily be of only moderate density in the agricultural districts, thin in the pastoral areas, and negligible in the arid tracts except where local circumstances (such as mining development) lead to oases of settlement. Apart from the towns, which present a special problem, the population is mainly in a relatively broad belt lying in the south-eastern margins, from north of Brisbane to beyond Melbourne, with outlying areas in the rift valley of South Australia, in the south-west corner, and in Northern and South-eastern Tasmania. That is to say, the bulk of the population is in the more temperate and better-watered areas within which agriculture can be established with relative success by the white population; there are very few people on what Professor Griffith Taylor calls the "frontier of settlement" surrounding the Arunta Desert and the central part of the Western Plateau—regions with no white population at all.

A remarkable feature of the distribution of population is the extraordinary concentration in the capital cities. The following table shows the estimated population of the six state capitals[1] at the end of 1929:

State	City	Population	Percentage of Total State Population
New South Wales	Sydney	1,238,660	49·0
Victoria	Melbourne	1,018,200	57·3
Queensland	Brisbane	318,631	34·2
South Australia	Adelaide	324,898	55·9
Western Australia	Perth	202,888	48·6
Tasmania	Hobart	57,500	26·2

Taking Australia as a whole, the population in the capital cities is nearly one-half of the total; this compares with rather more than one-third in 1911.

[1] The figures of population are for each metropolitan district, and therefore include suburbs. The largest of these districts is Sydney, covering 685 square miles.

The principal reason for this lies in the development of manufacturing industries and the concentration of trade and commerce in these cities. Other contributing factors are the slowness of development of the more remote districts and of closer settlement in the more favourable areas, together with the decline of mining, which has helped to reduce the non-metropolitan population, and with the attractions of city life in comparison with the isolation of pioneering conditions. It would appear that these capital cities carry a larger proportion of the population than economic necessities dictate; on the other hand, it should be remembered that there are no other really large cities (the urban population is about 62 per cent. of the total), and that primary production involves the extensive use of machinery, thus reducing the demand for labour.

The question is sometimes raised: What is the population that the continent could support? This question is, however, academic. Its answer involves a large number of considerations, such as the development of the sub-arid districts, the extension of closer settlement, the permanence of the 'white Australia' policy, and the limits of manufacturing development. The conclusion of Professor Griffith Taylor is that "there is probably room for 20,000,000 folk in the east and south, engaged in agriculture and manufactures, before any serious congestion can arise. Hence . . . the necessity for settling the arid and tropical sparselands does not seem to be at all urgent."[1] Other estimates reach a considerably higher figure.

Self-government and Federation

The beginnings of self-government date from the council of prominent colonists set up in 1824 to advise the Governor of New South Wales; this was followed by a legislative council, two-thirds of the members of which were elected, in 1842. The Australian Colonies Government Act of 1850

[1] "The Frontiers of Settlement in Australia," in the *Geographical Review*, January, 1926. See also *The Peopling of Australia*, edited by P. D. Phillips and G. L. Wood (Melbourne, 1928).

was passed to promote full self-government for the developing colonies; the Constitution for New South Wales was approved in the middle of 1855, and Victoria, which had been severed from New South Wales by the 1850 Act, received a similar constitution a few months later. Tasmania, known officially as Van Diemen's Land until 1853, had a constitutional history similar to that of New South Wales, receiving full self-government in 1856, that year seeing also the passing of the South Australian Constitution Act. Queensland had to wait till 1859. Western Australia ceased to be a Crown colony only in 1890, just before the development of the goldfields greatly increased its population.

In general the measure of self-government grew with the increasing size and importance of the local populations, until full status was achieved. Self-government for the different states had many advantages; it was, indeed, inevitable in view of the great distances separating the chief settled areas. But even before the setting up of the first state Constitution the suggestion of some sort of federal authority had been made.

Six different legislatures meant six different policies, and acute differences arose from time to time over varying tariffs and land laws, over irrigation, coloured labour, defence, and other problems. It is possible to exaggerate the importance of these differences, for there was much friendly rivalry between the states, as well as a growing feeling of unity. The movement for federation strengthened so much that a Federal Constitution was hammered out toward the end of the century, put to a referendum in five states in 1899, and agreed to by the requisite majorities. In 1900 the Imperial Parliament passed the necessary Act, and, provision having been made for the inclusion of Western Australia, a vote in that state completed federation in the same year.

The first Federal Parliament met in May 1901. Its powers were sufficiently restricted to reserve a large measure of autonomy to the state Parliaments, which continued with their lessened but considerable powers. Among the first-fruits of the creation of the Commonwealth were the abolition of inter-state tariffs, the development of a national fiscal

system, a uniform policy on coloured labour, a uniform postal system, and a national defence organization. It has furthered the growth of an intense national consciousness, and though state and Commonwealth interests sometimes clash, federation has resulted in a remarkable measure of unification.

The Commonwealth Government directly controls various territories. In 1911 South Australia was glad to hand over

FIG. 42. CANBERRA, FROM RED HILL

By courtesy of the Development and Migration Commission, Commonwealth of Australia

Northern Territory to the Commonwealth, together with a debt of £4,000,000, more particularly because the area was felt to be a Commonwealth responsibility. Five years previously the British Government had transferred Papua to the Commonwealth. Norfolk Island is also Federal territory. The League of Nations mandated to the Commonwealth certain former German territories—North-east New Guinea, the Bismarck Archipelago, part of the Solomon Islands, and Nauru (the last jointly with Great Britain and New Zealand)

—so that Australia, which had always been keenly interested in the affiliations of islands in the Pacific, was given definite responsibilities there.

Canberra. The Federal Parliament met in Melbourne, but

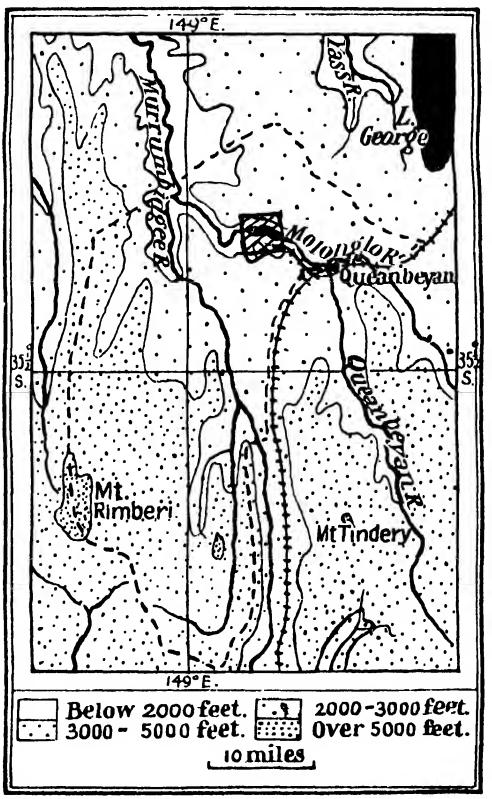

FIG. 43. FEDERAL TERRITORY AND THE POSITION OF CANBERRA

New South Wales desired the capital to be in her territory. This was agreed to on the understanding that the site should not be within a hundred miles of Sydney. It is characteristic of Australian individuality that, ignoring the claims of convenience and of the two outstanding cities, it should select a

Federal territory of 940 square miles in almost virgin country round the headwaters of the Murrumbidgee. A beautiful and well-planned city is arising at Canberra, with a magnificent Parliament House, first used in 1927. The territory has a population of rather more than 9000; it contains over 200,000 sheep and more than 5000 cattle, while wheat-growing has some importance. A short railway connects Canberra (population nearly 7000) with the New South Wales system at Queanbeyan, and a line has been surveyed to the port of Jervis Bay, where 28 square miles of land have been acquired for Commonwealth purposes. The development of a centre to be essentially Australian is indicated by the provision of a National Library, a National School of Forestry, a National Museum of Zoology, and a Solar Physics Observatory.

Occupations

The physical conditions of Australia and the character of its settlement have determined its development as a pastoral and agricultural continent, with the addition of mining as an occupation where the geological and other conditions are favourable. But the isolation which imposed dependence upon overseas sources for manufactured goods and for many of the amenities of civilized life led to an early and steadily growing interest in manufacturing industries. This provides the distinction between primary and secondary industries, and the attention given to secondary industries fostered by conscious state assistance is a marked feature of the economic activity. Primary production is concerned with the agricultural, pastoral, and mining occupations, secondary production with the treatment and manufacture of primary products and of imported raw materials. The emphasis upon industrial development has been a marked feature of the present century, and may largely be related to the establishment of the Commonwealth, which directed attention to the problem of building up secondary industries in Australia as far as possible independent of outside sources of supply.

That this policy has had a substantial measure of success

is illustrated by the proportions of the working population engaged in primary and secondary production at different periods.

Year	Primary Producers	Percentage of Working Population	Industrial Workers	Percentage of Working Population
1881	349,344	38·2	269,140	29·4
1891	419,499	30·7	419,455	30·7
1901	535,766	32·5	429,012	26·1
1911	608,843	30·4	569,132	28·4
1921	599,750	25·8	725,816	31·2

In the same period the number of persons classified in occupations described as 'commercial' increased from 83,918, or 9·2 per cent., in 1881 to 355,767, or 15·3 per cent., in 1921, and much of this increase must be attributed to the growth of factories and offices.

As the category 'industrial' includes not only persons in factory occupations, but those engaged "in other constructional work," some separate figures for factory-workers are illuminating. At the beginning of the century fewer than 200,000 persons were employed in factories; in 1926–27 the number exceeded 467,000. The added value in manufactured goods —*i.e.*, the contribution of the work of the factories to the finished product—increased from £33,000,000 in 1902 to £162,000,000 in 1926–27; the latter figure, when reduced in accordance with changed price-levels, represents an advance of 180 per cent. in the twenty-five years. The adjusted value of raw materials treated shows an increase during the same period of 170 per cent.

It would appear particularly from the figures of the last two censuses that primary production is occupying a decreasing proportion of the working population, while manufactures and commerce have absorbed substantially increased proportions. This, while gratifying to Australia as showing an increasing degree of self-sufficiency, is not without its serious aspect, for the intrinsic strength of Australia lies in her capacity for primary production to yield her principal exports and financial strength; her exports are essentially

exchanged for imports, mainly of manufactured goods. The largely artificial stimulation of secondary industries may conceivably have serious consequences if primary production should not maintain its relative position in economic development.[1]

State Activities

Although the work of the individual pioneer has been of outstanding importance in the development of Australia, the individual state Governments, as well as the Federal Government, have all deliberately and consciously aimed at promoting expansion in pastoral farming, in agriculture, in mining, and in manufacture. Few countries can show such widespread and varied state activity. The peopling of the continent has been encouraged by schemes of assisted settlement dating from an early period and the distribution of the population directed by the encouragement of closer settlement, a deliberate policy of breaking up large holdings to promote more intensive production and a denser population in districts where the conditions are favourable. State assistance to pastoralists takes many forms; of particular consequence is the drilling of large numbers of artesian bores. The dairy-farmer is inspected, and his products graded and guaranteed by the state. The agriculturist is given assistance in obtaining machinery, the large-scale use of which is a condition of economic production in a thinly populated land, while bounties and protective duties are designed to encourage the establishment of new crops such as cotton and rice.

Irrigation works have been directed by the different states to promote intensive development and close settlement in areas that were formerly pastoral. Agricultural research is another important aspect of state activity.

Mineral-prospecting is subsidized, and aid given in the initiation and development of mining enterprises. Manufactures have been deliberately built up behind a tariff wall, and with other artificial assistance, without which their success could hardly be assured; oversea firms have been

[1] See the report of the British Economic Mission to Australia, 1929.

thereby encouraged to establish factories within Australia. The railway development has been all but exclusively developed by the individual states, supplemented by the Commonwealth, and unprofitable lines have been run into almost empty territory to encourage settlement or for other reasons. Individual states, as well as the Commonwealth Government, have from time to time established particular enterprises, an outstanding example being the Australian Commonwealth Bank.

It is noteworthy that co-operative buying and marketing is an important development, especially in dairying and irrigation areas, while there is a strong tendency, encouraged by the state, toward stabilizing the marketing of the major primary products, wheat and wool, through bulk control.

Irrigation

Irrigation has played such an important part in the recent development of South-east Australia as to necessitate more detailed discussion. It is naturally most important in the Murray basin, where an enormous amount of summer flood-water is susceptible of utilization and large stretches of alluvial land can be reached with the assistance of appropriate control. Owing to the *régime* of the river and its tributaries, conservation of water is an essential feature, and immense sums have been devoted to the impounding of water behind barrages and the construction of regulating dams.

The first important irrigation settlement was at Mildura, in Victoria. Here irrigation is based upon pumping; operations began in 1888. This was followed by development lower down, at Renmark, in South Australia, in 1893; in the meantime a large storage and diversion scheme had been completed in 1891 on the Goulburn, in Victoria. Further use of the Murray water led to inter-state difficulties and the setting up of a permanent River Murray Commission to regulate the use of the Murray waters and to undertake construction works. Broadly speaking, each individual state controls waters actually within its boundaries, but provision is made for the use of the waters of the Murray itself so that

South Australia shall be properly provided for. The following table gives the diversion of water from the Murray in the year 1924–25:

	Acre-feet
New South Wales	950,865
Victoria	1,037,740
South Australia	94,269

It is perhaps not surprising that in South Australia complaints are made that the storage and use of the Murray

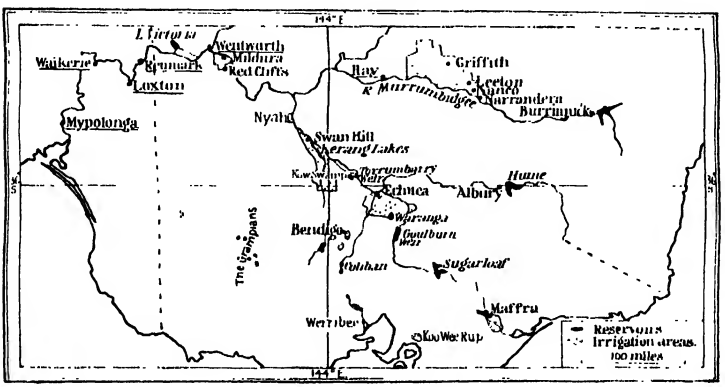

FIG. 44. IRRIGATION IN THE MURRAY BASIN
Minor irrigation centres, mostly with pumping schemes, are underlined.

water is causing a shallowing of the lower reaches and an increasing brackishness in Lake Alexandrina and Lake Albert, the water of which penetrates upstream when the river is at a low level.

Artesian water is seldom pure enough for irrigation, and only a few acres here and there can be watered from this source of supply. Pumping schemes are more important; by this method 1000 acres are irrigated at Hay, on the Murrumbidgee, while on the Murray some 14,000 acres are under irrigation at Mildura, and there are further small schemes at Renmark and other places in South Australia.

The largest schemes of the Murray basin are of the gravitation type, and involve large-scale storage. The Goulburn river scheme in Victoria was the first considerable one and

was originally based upon the Nagambie reservoir, which raises the summer level forty-five feet, with storage in the Waranga basin, a natural depression. Later the Sugarloaf dam (140 feet high, and with a hydro-electric installation) was constructed for further storage higher up the river, and the whole scheme commands nearly a million acres of irrigable lands, though only a proportion of this is actually watered by it. Echuca is the principal settlement in this area, and below this town the Torrumbarry weir, on the Murray, raises the summer level of the river sixteen feet, and allows of considerable irrigation by gravitation. This weir is utilized to supply water for storage in a number of lakes by the river. The Loddon river also supplies some water, but is far less useful than the Goulburn.

On the Murrumbidgee is the Burrinjuck dam, with a diversion weir 240 miles lower down, for an area of 200,000 acres of irrigable lands. There is a complete system of channels, main and subsidiary, with regulating structures, and the area contains the New South Wales experimental farm at Yanco.

There are now storages on the Coliban river (running northward from the central highlands of Victoria), which supply water to Bendigo and the surrounding district. Farther west, four reservoirs at the foot of the Grampians store water for domestic and stock purposes in the Mallee country.

The River Murray Agreement between the three interested states and the Federal Government resulted in the undertaking of co-ordinated schemes, still in process of completion. The Hume reservoir, under construction just below the junction of the Mitta Mitta with the Murray, will store 2,000,000 acre-feet of water, derived from a catchment area of well-watered mountainous country. A big hydro-electric scheme is being undertaken at the same time. The stored water should permit of much more irrigable land lower down the river being brought into cultivation. An already completed part of the whole scheme involves the provision of water to Lake Victoria in the south-west corner of New South Wales for use in South Australia, the storage capacity being about 500,000 acre-feet.

The total area of irrigable land in the Murray-Darling basin is estimated to be 1,500,000 acres. Outside the Murray basin the biggest irrigation scheme is in the Dawson valley, Queensland, where at Nathan's Gorge a storage of 2,500,000 acre-feet (combined with a hydro-electric scheme) is being made available behind a dam more than 130 feet above the summer level of the river. Some 200,000 acres of irrigable land are available lower down. There are a number of small schemes along the coastal rivers of Queensland and New South Wales and in the south-west of Western Australia. Also worthy of note is the Maffra scheme, at the eastern end of the Victorian valley (where a reservoir at Glenmaggie, on the Macalister river, subserves the production of sugar-beet and dairy produce), as well as the small scheme on the Werribee river, running into Port Phillip west of Melbourne. The New South Wales Government is investigating the possibilities of storage in the Macquarie and Lachlan rivers; in the case of the latter river a dam at Wyangala is proposed, with which might be combined a hydro-electric undertaking.

COMMUNICATIONS

It is not surprising that in the early days of development the principal method of transport was by means of bullock-wagons and horse-teams, while the camel was introduced at an early stage for transport in the more arid districts. To-day the motor-car and the motor-lorry are largely displacing these older means of transport, and national highways and subsidiary roads are being rapidly extended. There are now some 650,000 motor vehicles in Australia—about one for ten inhabitants.

Navigable Waterways. The rivers are of little value, although it is expected that the Murray—used to some extent by shallow-draught vessels—will become a much more important highway when the proposed series of weirs and locks along its course is completed. The Darling and the Murrumbidgee will, it is hoped, be equally improved. In favourable periods the limits of navigation on the Darling, Murrumbidgee, and Murray are respectively Walgett, Narrandera, and

Albury, but in general the respective limits are Menindee, Hay, and Echuca.

The River Murray Agreement, arrived at largely at the instigation of South Australia, which was concerned about the interference with the navigability of the Murray caused by storage and removal of water for irrigation, included a scheme for a series of thirty-five weirs and locks, nine on the Murrumbidgee below Hay, seventeen on the Murray between

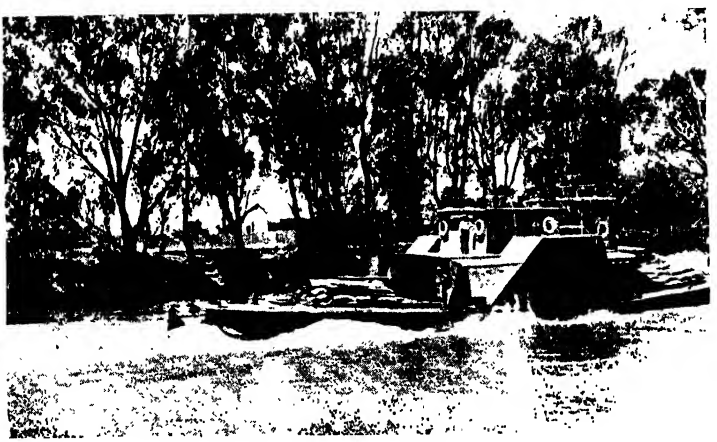

FIG. 45. WHEAT BARGE ON THE MURRAY
Note the gum trees lining the bank.
By courtesy of the Immigration Office, Commonwealth of Australia

Echuca and Wentworth, and nine on the Murray below Wentworth. Of this programme, the nine below Wentworth (constructed by the South Australian Government), two on the Murray just above (constructed by the New South Wales Government), and the Torrumbarry weir (constructed by the Victoria Government) have been completed. The object is to keep open the Murray between Echuca and its mouth (1066 miles) for permanent navigation by small steamers. Despite the provision of locks in the Murray, the use of the river has not apparently increased. The weirs seem to have increased silting in the lower course. The principal traffic on it is the seasonal transport of wool to the rail terminals. The

development of railways and of motor transport in the Murray basin has in fact tended to a decreasing use of the river, for transport is unlikely to become large unless a port is created at its mouth, a costly project in which South Australia is specially interested.

Short sections of the lower courses of eastern coastal rivers have a limited value, while if the north should ever be developed, several rivers, such as the Fitzroy and the Roper, would prove useful.

Railways. Of necessity Australia has developed railways, which now have a total length of about 28,000 miles. But there is no real railway-system, owing to the individual states having built up their railways independently. This in particular has resulted in a nonconformity of gauge that has long been realized as a serious hindrance to through traffic and as a strategic disability in a possible time of emergency.

As might be expected, the two most developed states have the two most centralized systems. This is specially well marked in Victoria, where Melbourne, situated at the dominating opening in the coastline, is the centre of a number of lines radiating east, west, and north; the physical control is very notable. In New South Wales Sydney is the nodal railway centre, and the domination of Melbourne and Sydney in population and commerce is largely attributable to their railway communications. Elsewhere in Australia there is no comparable development.

The Eastern Highlands not only presented considerable engineering difficulties, but help to account for the characteristic features of the railways in the east. The railway may be followed clinging more or less to the coast from Cairns to south of Sydney, but no line passes along the coast into Victoria, because the highlands come so close to the sea, especially noteworthy being the ridge that projects at Cape Howe. The Kilmore Gap secured easy access for Melbourne into the Murray basin, but in Queensland there is a string of ports in Cairns, Townsville, Rockhampton, and Brisbane, each with a railway running westward into the interior of the state. Here, as in the other eastern states, the object has been to connect the interior agricultural, pastoral, or

mining centres with the coast, but it is worthy of note that between Brisbane and Melbourne there are long stretches of railway that follow the interior flank of the Eastern Highlands.

In the Murray basin development has been mainly based upon railways, and it is extremely doubtful whether the system of weirs and locks will render the river seriously competitive. From Melbourne numerous lines reach the Murray, as well as a number from the New South Wales side. The river carries railway-bridges at a number of places, including Albury, Yarrawonga, Echuca, Gonn Crossing, Euston, and Mildura. In South Australia Morgan is linked with Adelaide, and in New South Wales Sydney sends out tentacles to tap the Murrumbidgee at Hay and the Darling at Menindee and Bourke. Newcastle is linked with Walgett.

In South Australia there is a peculiar development, largely the result of the settlement being mainly confined to the rift valley round the two funnel-shaped openings, the St Vincent and Spencer Gulfs. There is a certain radial arrangement from Perth in Western Australia; elsewhere in the west and north there are only a few relatively short lines running inland from Geraldton, Port Hedland, and Darwin. Tasmania has a through line from Hobart to Launceston, and some other limited development, chiefly in northern districts.

Nearly all the mileage open for general traffic is owned by the individual states or by the Federal Government. The railways of Queensland, Western Australia, and Tasmania are of narrow gauge (3 feet 6 inches); in New South Wales the gauge is standard (4 feet 8½ inches); in Victoria it is wide (5 feet 3 inches); while in South Australia all three gauges are met with. The principal Federal lines are (1) from Darwin nearly to Daly Waters (3 feet 6 inches), (2) from Port Augusta to Alice Springs (3 feet 6 inches), (3) from Port Augusta to Kalgoorlie (the trans-Australian line, of standard gauge).

It is theoretically possible to travel by train from Cairns through all the state capitals to Murchison, in Western Australia. An analysis of the journey from Brisbane to Perth—nearly 3500 miles and taking six days—illustrates

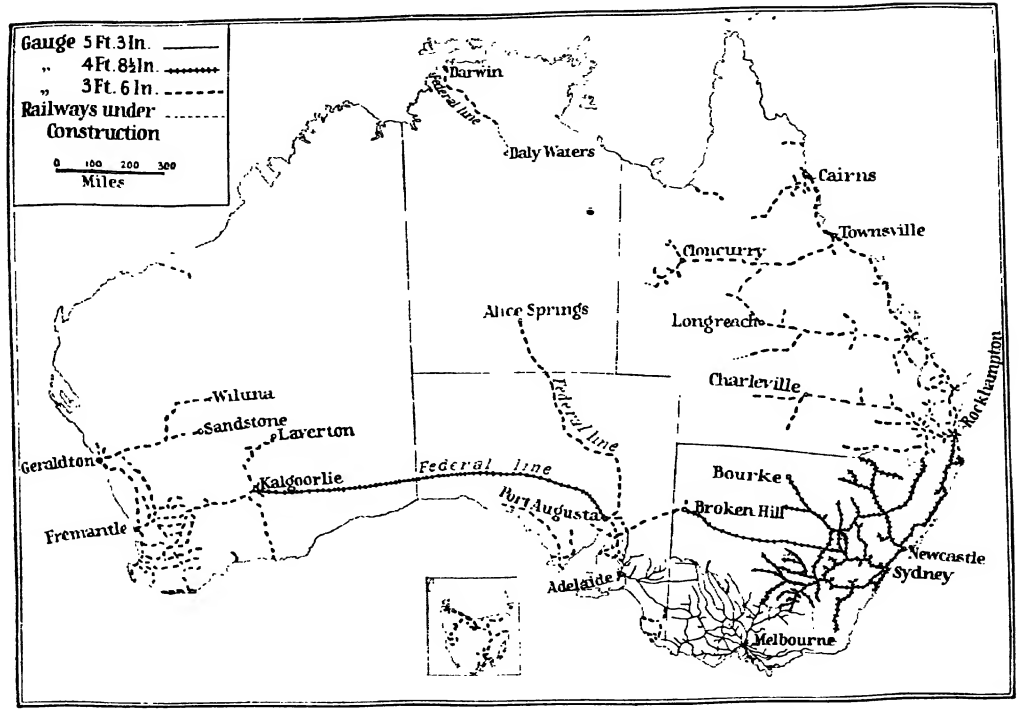

FIG. 46. AUSTRALIA—PRINCIPAL RAILWAYS AND GAUGES

Based on a map in the Commonwealth "Year-book"

clearly the inconvenience of the existing railway development. One break of gauge is now avoided by the recent construction of a standard-gauge line from South Brisbane to Kyogle, inside the New South Wales border. At Albury the Victorian wide gauge is used, which goes on through Melbourne to Terowie, a station north of Adelaide, in South Australia, but, in addition to the change of trains at Albury,

FIG. 47. THE TRANS-CONTINENTAL EXPRESS CROSSING THE TREELESS NULLARBOR PLAIN

By courtesy of the Development and Migration Commission, Commonwealth of Australia

fresh trains are used at each capital city. A narrow-gauge line runs from Terowie to Port Augusta, from which point there is a clear run on standard gauge to Kalgoorlie, across the Nullarbor Plain, which is without a single permanent stream. (The bores of this region provide saline water, so that storage of fresh water at intervals along this line is necessary for supplying the engines.) From Kalgoorlie to Perth a narrow gauge is used. It is noteworthy that the standard-gauge line running from Sydney to Broken Hill, if extended for 300 miles to Port Augusta, would effect a remarkable improvement in trans-continental traffic.

Many conferences have been held to discuss the gauge

problem. In 1921 agreed proposals were formulated; standard gauge was recommended for a through line from Brisbane to Fremantle, as well as the conversion of all the non-standard gauge lines in Victoria and South Australia. This would cost a very large sum.

It is of considerable importance that a deliberate policy of constructing lines into sparsely peopled or empty districts to pave the way for settlement and development has been

FIG. 48. ODNADATTA, NORTHERN SOUTH AUSTRALIA
Camel transport serving the railway.
By courtesy of the Immigration Office, Commonwealth of Australia

generally pursued. Some lines, on which perhaps a train runs twice a week, or even less frequently, necessarily show a financial loss, but it does not follow that in the long run this policy is uneconomic; nevertheless, it is subject to a great deal of criticism.

Aerial Development. The wide and thinly populated spaces of Australia, together with generally favourable atmospheric conditions, have led to considerable development of a means of transport that is relatively independent of surface conditions. Under state encouragement there are now some 6000 miles of regular air-routes and 2700 miles of private lines. Thus Cloncurry and Daly Waters are served from Brisbane, Hay from Melbourne, Mildura and Broken Hill from

Adelaide, and the west coast as far north as Derby from Perth, while a route has been opened between Perth and Adelaide which saves a substantial amount of time for passengers and mails. The services are generally weekly or twice weekly. When it is remembered that the time taken for the mail between Darwin and Brisbane is reduced from one month to four days, it is clear that this subsidiary means of communication is of considerable value. For emergency use, as, for example, carrying the doctor to isolated stations or fodder to stock during drought, there is a wide sphere of usefulness for aircraft.

An experimental transmission of mail by air from England to Darwin *via* India and Singapore has recently taken place. A continuation to Darwin of the existing Dutch air-line, which reaches Batavia by the same route, has also been proposed.

Oversea Communications. Although Australia is remote from Europe, her commercial importance is such as to ensure well-developed shipping services. Thus the liner services average more than two sailings per week each way between Australia and Britain. The position of Australia, moreover, is such as to command traffic *via* both the Suez and Panama Canals, as well as *via* the Cape of Good Hope and Cape Horn. There are sailings from the maritime countries of Europe, Dutch boats reach Australia *via* Java, important connexions exist with Vancouver and California *via* Fiji and Hawaii, while contact is maintained with Indian and Japanese ports.

The shortest way from Britain is through the Suez Canal; the route London–Suez–Colombo–Fremantle is 9537 nautical miles. Fremantle, however, is remote from the south-east region, which yields the heaviest traffic, but the trans-continental railway and the aeroplane service have considerably added to the importance of Fremantle for passengers and mails. Melbourne is another 1650 miles farther, and Sydney is 576 beyond that, giving a total of 11,763 miles from London. This compares with 12,222 miles between Liverpool and Sydney *via* the Panama Canal, so that Sydney is roughly the same distance from Britain by these two routes; there are, however, many more ports of call *via* Suez.

A good deal of traffic reaches Australia by way of Cape

Town, as the further 1000 miles of steaming (in comparison with the Suez route) is compensated for by the avoidance of canal dues. The great circle route *via* the Southern Ocean is avoided, as it passes near the danger zone of the Antarctic ice. On the return voyage round the Cape a call is usually made at Durban for coal, the more northerly course escaping to some extent the westerly winds. The cargo carried—*e.g.*, wool—is often valuable enough to make it worth while to use the Suez Canal.

An important effect of the cutting of the Panama Canal was to bring Eastern Australian ports much nearer than formerly to the manufacturing region of the United States. Thus New York, which by the Cape route is 13,083 miles from Melbourne, was brought within 10,400 miles *via* Panama, which compares with 11,654 miles from Liverpool to Melbourne *via* Suez or 12,966 miles *via* Panama. The shortest routes to Sydney from New York and Liverpool give a decided advantage to the former port. Nevertheless, the principal channel of Australia's oversea trade is through Suez.

There is little traffic across the wide spaces of the Pacific between Australia and South America, but many boats returning to Europe take advantage of favourable winds to Cape Horn to reach home *via* the Atlantic. Few sailing ships are now engaged in the shipping industry, but a few survive in the grain trade between Europe and Australia. Such vessels go out by the Cape, cutting across the south-east trades in the Atlantic Ocean, and utilizing the west winds to carry them to Australia; they return by Cape Horn, helped by the south-east trade in the South Atlantic, but making a wide *détour* in the North Atlantic before the west winds carry them home. (See Fig. 12.)

In 1927-28 the oversea shipping that entered Australian ports was made up as follows:

	No. of Vessels	Tonnage
Steamer	1,544	5,373,485
Sailing	33	45,560

There is a very considerable coastwise traffic, which is, however, statutorily confined to vessels on the Australian register.

The relative importance of the leading ports may be gauged from the following figures for 1927–28:

TOTAL SHIPPING TONNAGE ENTERED

Sydney	9,212,295
Melbourne	7,049,513
Adelaide	4,665,152
Newcastle	4,569,813
Fremantle	3,424,375
Brisbane	3,361,076
Townsville	1,061,944
Hobart	885,639

CHAPTER IV

AUSTRALIA: ECONOMIC GEOGRAPHY

THE general lines of Australian development have already been indicated. Carefully fostered secondary industries have been added to the pastoral, agricultural, and mining occupations, but in developing the latter one natural resource has suffered considerably. The wealth of the continent in trees of economic importance has seriously declined, and only in relatively recent years has attention been given to their conservation.

FORESTRY

Only a comparatively small portion of Australia is devoid of tree or shrub growth, though much of it is necessarily of a xerophilous and stunted character. The areas which are naturally thickly timbered are confined to the well-watered margins, the 70-inch isohyet roughly indicating the limit in the tropical and the 30-inch isohyet in the extra-tropical latitudes. Unfortunately, these areas are among those best suited to agriculture, and have been largely cleared in the early days of settlement with little discrimination, so that the forests remaining for commercial exploitation and the forest reserves that have been created in each state are mainly in more elevated and inaccessible districts, in which fire control (a very important aspect of forestry in Australia) is relatively difficult. The principal true forest areas are found in the south-west corner, between Perth and Albany, in the Otway and Gippsland districts of Victoria, on the coastal margins and mountain slopes of Victoria, New South Wales, and Queensland, and in Tasmania. A belt of woodland is often found along the rivers, such as the belt of red gum along the Murray and its tributaries.

There is a large import of softwood from North America

and Scandinavia, as Australia is not rich in timber of this type. The chief soft timbers include the red cedar of the hot, wet margins of Queensland north of Ingham, a handsome dark red wood widely used for furniture, and the Huon and King William pines of West and South-west Tasmania. It is of interest that many plantations of introduced conifers, notably the Monterey pine—a quick-growing species—are

FIG. 49. A BUSH SAWMILL IN SOUTH-EAST AUSTRALIA
By courtesy of the Immigration Office, Commonwealth of Australia

being made especially in South Australia, which is very deficient in timber.

Most of the hardwoods are eucalypts, an exception of some importance being turpentine, a broad-leaved tree of the eastern forests, used for wharves and piles because of its resistance to teredo-borers. The eucalypts are remarkable for their strength and durability, as well as for their rapid growth, and in many instances for their great size. Among them is ironbark, four varieties of which are found in the extra-tropical forests of the east; it is remarkably resistant to decay and even to fire, and is widely used for heavy

timber and for railway-sleepers. The forests of the south-west corner include the eucalypts jarrah, karri, and tuart; the first is very valuable for piles, sleepers, and wood-paving blocks; karri is very tough, heavy, and dense, is less easy to work, but is useful where hard-wearing timber is needed. Many other eucalypts, among which the mountain ash of Gippsland is worthy of mention, provide valuable timber for joinery, flooring, furniture, wheelwrights' work, and other purposes, while there is a big demand for timber for posts, fencing, and fuel.

Sandalwood is of some importance in the scrub areas of Western Australia; it is exported to China for making joss-sticks and for ornamental purposes, and a little oil is also extracted. Other products from Australian trees include eucalyptus oil, extracted chiefly in the south-east from the leaves of young gums; besides having value in medicine, the oil is used in certain smelting processes. Many trees, both eucalypts and acacias, yield tannin, but the total production of tan bark is not very great. There is some export, chiefly of mallet bark (from Western Australia), but in recent years greater quantities of tan bark have been imported, mostly from Natal, where the wattle plantations—grown from Australian seed—have greatly flourished.

In the year 1927 28 timber imports were valued at about £5,500,000 and exports at about £1,250,000; the sandalwood exports reached nearly £200,000. With more scientific methods of forest conservation and exploitation, to which serious attention has been directed only in recent years, the timber industry of Australia is likely to become increasingly important.

Pastoral Production

Among the natural advantages of Australia for stock-rearing are the abundance and drought-resisting properties of the native grasses and other fodder plants. The indigenous grasses are excellent for animals reared both for fattening and for the production of wool, and in a land suffering seriously from drought it would be impossible to replace them by cultivated plants; the vegetation renews itself

remarkably after drought. It is true that in more temperate and wetter areas, where settlement is closer, other plants have been successfully introduced, particularly for dairying purposes. Thus paspalum, a member of the millet family from South America, has done well in the coastal districts of New South Wales and Egyptian clover in South Australia.

Grasses of the summer rain areas are of greater variety and

FIG. 50. A STATION IN NORTHERN SOUTH AUSTRALIA
Note the vegetation, the two wind-pumps, and the water-tank.
By courtesy of the Immigration Office, Commonwealth of Australia

of greater feeding value than those in the regions in which the principal rainfall comes in winter, and are therefore better suited to cattle than to sheep, although the shorter types more suited to sheep grow plentifully among the larger ones. The Mitchell grasses common on the black and red soils of the interior of New South Wales, Queensland, and Northern Territory are among the best known. The enemies of the native grasses are rabbits, drought, and over-stocking. Their growth is inevitably slow in drought periods, and much country has been depastured through over-stocking, which prevents adequate seeding. Attention is being given to the

conservation of the natural pastures and to the breeding of native grasses, which, experiment has shown, can be improved.

In addition to the grasses, there are numerous saltbushes adapted to alkaline soils. Possessing succulent leaves and deep roots, these plants grow on a small rainfall, are very resistant to drought, and, though not usually eaten by stock when other herbage is available, they prove an important reserve in dry periods. Saltbush has not the fodder value of the grasses, but will keep sheep in reasonably good condition for a long time. Some varieties have a creeping habit, others grow to considerable size; thus old man saltbush, common in the drier parts of Queensland, New South Wales, Victoria, and South Australia, grows to a height of ten feet.

The number of each of the different types of stock varies considerably from year to year, mainly as a result of periods of drought. Australia has suffered seven droughts since the opening of the century, the last being prolonged in many pastoral districts over several years.[1] The country recuperates rapidly when the good rains return.

Horses. The importance of the horse in a stock-rearing and agricultural country like Australia can hardly be overstated. There were 2,000,000 horses in 1927, of which Queensland, with its great cattle-ranches, had 27 per cent. To the stockman the horse is indispensable, although the motor-car has largely displaced other vehicles, even on the cattle-station. Horses are bred in large numbers for farm use, and though the tractor is being increasingly introduced, it is not surprising that there are many horses in the agricultural districts. New South Wales has rather more than Queensland, and, despite its small size, Victoria has 21 per

[1] "Reports from Alice Springs state that in consequence of the recent torrential rains the river Finke is running for the first time in seven years. Many children have never previously seen rain, and they will soon see the drought-stricken country carpeted with wildflowers. The rains mean the turning-point in the fortunes, or rather the long misfortunes, of many station-owners."—*The Times*, January 27, 1930.

"The drought that has held in its grip wide areas of the pastoral districts of Queensland for periods ranging from four to seven years has been definitely broken by the occurrence of general monsoon rain."—*The Times*, January 29, 1930.

cent. of the whole number in the country, while South Australia has 11 per cent. and Western Australia 8 per cent. Tasmania, as might be expected from its physical conditions, has relatively few horses, but Northern Territory, although its total is small (2 per cent.), has by far the greatest number per head of population.

There was at one time a considerable export trade in horses, especially to India, for remount purposes. It has

FIG. 51. MOB OF THREE THOUSAND BULLOCKS OVERLANDING FROM THE GULF COUNTRY (NORTH QUEENSLAND) TO NEW SOUTH WALES

By courtesy of the Immigration Office, Commonwealth of Australia

declined to small proportions in recent years, India being still, however, the chief market. The tendency for the horse population to decline, which has been noticeable for some years, is likely to continue with the increasing use of motor-transport.

Cattle. In 1927 the total number of cattle was rather more than 11,500,000, having declined owing to drought and a falling-off in the frozen beef trade from a maximum of nearly 14,500,000 in 1921. Broadly speaking, cattle are chiefly reared in the regions of good rainfall, and show the greatest concentration in the well-watered coastal districts lying north and south of the Queensland-New South Wales boun-

dary and in the Otway and Gippsland districts of Victoria. On the other hand, the use of artesian water in more arid districts has facilitated ranching, especially in the savanna belt, while as cattle are less averse than sheep to tropical latitudes, they show a more general distribution over the continent. It is noteworthy that tick fever hinders cattle-rearing in the Cape York Peninsula.

The bulk of the cattle are beef cattle, raised on a more or less extensive scale for slaughtering purposes. Where settlement is closer, and the climate and other conditions favourable, dairy cattle are being increasingly reared. The following table shows the distribution of cattle among the different political divisions for the years 1923 and 1927:

Division	Cattle and Dairy Cows			
	All Cattle		Dairy Cows	
	1923	1927	1923	1927
New South Wales	2,032,000	2,849,000	785,000	894,000
Victoria	1,591,000	1,436,000	738,000	626,000
Queensland	6,397,000	5,226,000	513,000	645,000
South Australia	413,000	316,000	136,000	118,000
Western Australia	954,000	847,000	62,000	71,000
Tasmania	220,000	211,000	70,000	67,000
Northern Territory	844,000	835,000	Not available	
Federal Territory	6,100	6,200	400	1,400
Totals	13,357,100	11,616,200	2,304,400	2,422,400

So far as the total of cattle is concerned, it is clear that Queensland dominates, with nearly half the number, while the large number of Northern Territory (having regard to its scantily peopled character) is also significant. The table also brings out the very high proportion in relation to area of dairy cattle in Victoria. In general the figures show a distinct decline in the total number of cattle, but an increase in the number of dairy cows, suggesting the growing importance of dairying; they also provide a reflection of the varying physical conditions in the different political divisions.

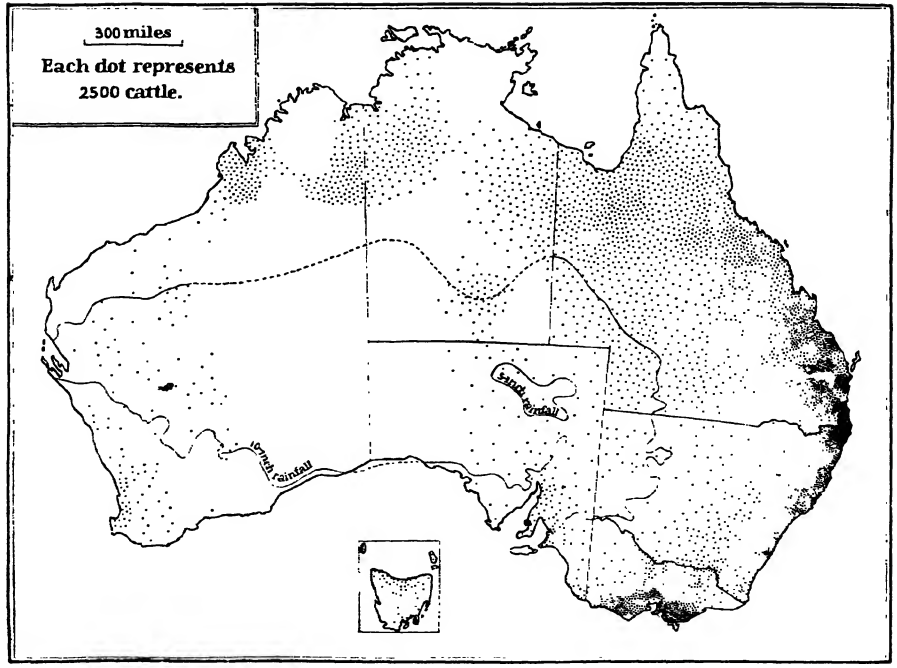

FIG. 52. AUSTRALIA—DISTRIBUTION OF CATTLE, 1924–25

Commonwealth "Year-book"

It may be noted here that there is only a small export of live cattle, and that the small import of cattle is mainly confined to pedigree stock for breeding purposes.

Beef Cattle. The cattle-rearing industry has been greatly helped and stabilized by refrigeration and canning, which have made possible an export trade in beef; this export trade has been subject to considerable fluctuations, and has even been subsidized by the Federal Government. An expanding population provides an increasing market (the consumption of beef per head of population is very high), and some 2,500,000 cattle are annually slaughtered for home consumption; in relation to the home trade in beef the exports are comparatively small.

While beef cattle are reared wherever cattle-raising is carried on, it is in the savanna belt that they are particularly found. This is illustrated by the small proportion of dairy cattle in Queensland, Northern Territory, and Western Australia, traversed by the zone of tropical grassland. Cattle-runs, extending in some cases to thousands of square miles, characterize this region, but the distribution of the animals is not uniform, being dependent to a large extent upon the quality of the pasture and upon the water-supply. Thus, in Northern Territory the basin of the Victoria river and the Barkly Tableland—both outside the artesian areas—contain most of the cattle. There are large numbers in the Kimberley district of Western Australia and in the Fitzroy basin, largely served by artesian water, while Central Queensland is similarly favoured. There is a number of large stations round the Macdonnell Ranges in Central Australia, and artesian water permits cattle-raising even in arid districts like the Eyre basin, though such areas are necessarily only lightly stocked. The beasts on these extensive runs—chiefly Shorthorns and Herefords—are of enormous size, and dwarf the dairy cattle of the wetter and more temperate regions. They may be fattened on the stations or near to the markets at which they will be slaughtered; herds may be driven hundreds of miles to the railhead, artesian bores being invaluable for keeping open the stock routes, and it is a tribute to the quality of the native grasses that the

beasts generally keep in good condition during the long journeys.

Other areas of importance for beef cattle are the Upper Hunter and Upper Murray districts, which supply much beef to the towns of the south-east. Freezing and canning works are chiefly important in Queensland, while the hides are either absorbed by Australian tanneries or exported.

FIG. 53. LAND CLEARED FOR DAIRYING, NORTH COAST OF NEW SOUTH WALES

ce of settlement has involved l ch destruction of f

By courtesy of the Immigration Office, Commonwealth of Australia

Dairy Cattle. As the foregoing table shows, the proportion of dairy cattle in New South Wales, Victoria, and Tasmania is large, while the big total of all cattle in Queensland masks the large numbers of dairy cows kept in the south-east of that state, an area in which dairying has made particularly rapid progress in recent years. It is not surprising that dairying should concentrate in the wetter margins of the more temperate latitudes, quite apart from the large local market due to the concentration of population in those

districts. The dairy cattle are chiefly Shorthorns, Ayrshires, or Jerseys, and are small in comparison with the huge beef cattle of the interior.

The coastal dairying belt extends from north of Brisbane through New South Wales to Gippsland and the Otway district of Victoria, the principal break being in a district round the Hawkesbury river, in the hinterland of Sydney, where a large area of poor sandstone is unfavourable not only to dairying, but to general agricultural pursuits. Dairying can be carried on with reasonable safety in this coastal belt, where the rainfall exceeds about 40 inches in the warmer latitudes and 25 inches in Victoria; nevertheless, the silo for storing fodder is an important feature of the farms on which dairy cattle are kept, and large quantities of hay (chiefly wheaten and oaten hay) are grown. Factories for butter- and cheese-making are scattered through the dairying districts, and there is an export trade in butter, cheese, and condensed and dried milk.

In neither South Australia nor Western Australia is dairying firmly established; that is to say, while the requirements of the local markets are mainly met, there is no surplus of milk products for export. In these states the temperate districts with a reasonably good rainfall suffer from summer drought, and therefore are climatically less well suited than the south-east for dairying purposes, although this hardly applies to the well-watered south-west corner of Western Australia. The numerous short coastal rivers of the south-east, where there is no well-marked dry season, are very favourable to this occupation.

Irrigation has made possible a considerable development of dairying. Irrigated land, upon which close settlement is aimed at, is necessarily relatively expensive, and the production of butter and cheese—commodities that will bear considerable freight charges—is a feature of such districts. The keeping of dairy cattle based upon the growth of fodder crops—lucerne being prominent among these—is an almost invariable accompaniment of irrigation, and in such districts co-operative methods are facilitated by the relatively small size of the holdings. New South Wales and Victoria, the

states in which irrigation is most developed, thus have their coastal dairy herds supplemented by dairy cows in the drier interior. The coastal districts, however, dominate in this occupation; at present only 10 per cent. of the dairy cows in Victoria are in irrigation areas.

Since the beginning of the century the production of butter and cheese has more than doubled, and the value of the

FIG. 54. DAIRY HERD FEEDING ON LUCERNE
Lucerne is largely grown for dairying in irrigation districts.
By courtesy of the Development and Migration Commission, Commonwealth of Australia

exports, which has fluctuated considerably, in 1927-28 reached nearly £7,000,000 in the case of butter and £260,000 in the case of cheese. In addition there was an export valued at nearly £1,250,000 of concentrated and preserved milk, in the production of which Victoria predominates. The high quality of Australian butter is attributable among other things to the sunny, open-air conditions in which the cows graze all the year round and to the careful supervision of the production at all its stages.

Sheep and Wool. The production of woolled sheep dominates

the economic activity, and in this Australia leads the world. Since 1890 the total number of sheep has fluctuated considerably round a mean of about 85,000,000, the variations being largely due, of course, to drought.[1] On the other hand, in recent years, owing to the use of artesian water and of other water-supplies, together with greater care in stocking the runs (the aim of which is not to stock an area up to its capacity in a favourable year), the fluctuations have not been striking. The maintenance of this huge number is remarkable in view of the fact that some 12,000,000 sheep and lambs are slaughtered annually for their meat. Australia contains some 15 per cent. of the world's sheep, more than any other political division of the world, except Russia, while in the quality and quantity of wool production she is without a rival.

This great industry may be said to date from 1797, when merino sheep were introduced from the Cape of Good Hope. Captain Macarthur, described as "the father of sheep-farming in Australia," established the first extensive sheep-farm at Camden, in New South Wales, in 1805. The penetration of the areas inside the coastal districts was, however, necessary for the development of the industry, and the remarkable increase in the number of sheep dates from about 1860, when the total was only some 20,000,000.

Sheep on the whole prefer more temperate conditions than do cattle, and although there are considerable numbers in certain parts of the savanna belts, especially in Western Australia and in the artesian area of Central Queensland, the principal concentration is in the more temperate areas of the south-east, in New South Wales and Victoria. Sheep cannot compete with cattle in the wet coastal lowlands, and are chiefly found in the belt enclosed between the 15-inch and 30-inch isohyets, though they occur in considerable numbers in areas in which the rainfall may decline much below 15 inches. The open plateau lands of New South Wales carry large numbers, as does the interior slope of the

[1] The maximum number of sheep, exceeding 106,500,000, was recorded in 1891; this declined to half that number by 1902. The latest figure shows an approximation to the maximum.

Eastern Highlands in that state, the density declining toward the more arid west and north-west of the state. There is a notable concentration on the volcanic soils in the western half of the Great Victorian Valley. In Tasmania sheep avoid the bleak and wet western half of the island. The merino type predominates even in Tasmania, but the heat and sunshine of the mainland leads to deterioration, so that more

FIG. 55. MOB OF SHEEP CROSSING A CREEK
By courtesy of the Immigration Office, Commonwealth of Australia

vigorous stock, chiefly from temperate Tasmania, has constantly to be introduced. The breeding in Central Tasmania of merino flocks of high standard is very important to the mainland industry. While the merino type predominates—with various sub-types adapted to different climatic and pasture conditions, a large type being associated with the plains and a smaller breed with the highland pastures—other breeds, such as Lincoln, Leicester, Shropshire, and Southdown, are found in the more closely settled as distinct from the more specifically pastoral areas. They are crossed in increasing numbers with merinos for the mutton and lamb trade.

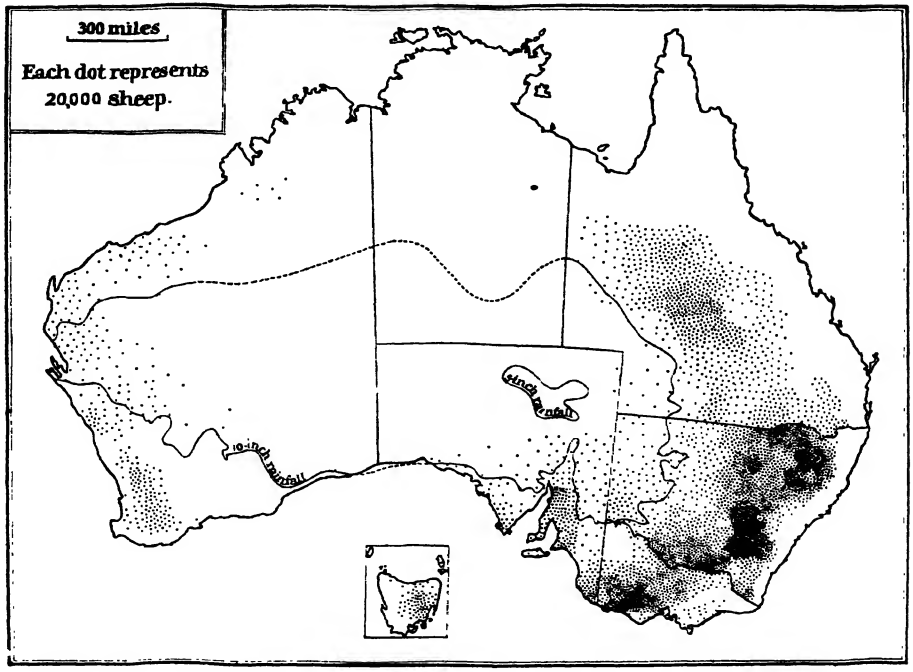

FIG. 50. AUSTRALIA—DISTRIBUTION OF SHEEP, 1924–25

Commonwealth "Year-book"

The distribution of sheep, totalling 101,000,000, among the political divisions in 1927 was as follows:

	Percentage
New South Wales	49·99
Queensland	16·54
Victoria	15·46
Western Australia	8·40
South Australia	7·50
Tasmania	1·89
Federal Territory	0·21
Northern Territory	0·01

These proportions show relatively little change from year to year; they need to be judged in relation to the areas of the states and to the climatic conditions. Upon improved land in districts of good rainfall where sheep-rearing is not the sole preoccupation the sheep density reaches 1 per acre, while on the large, purely pastoral properties of the more arid interior it declines to about 1 per 30 acres. It is noteworthy that the tendency to-day is toward working the sheep industry on a smaller scale than formerly. A recent return showed that out of 78,415 flocks thirteen exceeded 100,000 sheep, and 51,400 were of fewer than 500 sheep. Putting the point in another way, out of the same total (78,415) of land-holdings, some 46,000 were smaller than 1000 acres, while there were 707 holdings exceeding 100,000 acres; this small number of large holdings supported some 20 per cent. of the total number of animals. But closer settlement and agriculture have killed squatting over large areas.

It will be noted, by comparing the maps showing the distribution of wheat and sheep, that the areas growing most wheat largely coincide with areas having great density of sheep, although this is not true of Queensland and Western Australia and of part of Victoria. Wheat-growing clearly is largely combined with sheep-rearing; the wheat-grower is thus not dependent solely on his crop. He can devote a portion of his holding to fodder, and by a judicious use of hay and ensilage he can weather an adverse season. A flush of growth on the fallow after rain and the stubble after harvest are the sources of fodder, while if the wheat or oat crop is growing too rapidly after autumn rain it can be kept down by turning in the sheep. On such farms the sheep are

largely cross-breds, the progeny of merino ewes mated with long-wool English rams. Cross-breds of Lincolns or Leicesters give both good fleeces and good carcases. For fat-lamb production rams of Dorset, Shropshire, and Southdown breeds are usually employed. Cross-breds for mutton are

FIG. 57. SHEARING BY MACHINERY

The use of large-scale machinery economizes labour, and allows an increase in primary production without a corresponding increase in the labour-supply.

By courtesy of the Development and Migration Commission, Commonwealth of Australia

also largely reared in the highlands where the rainfall is substantial.

Water-supply is clearly very important in the regions of smaller rainfall. The conservation of water behind dams on streams or in hollows which collect the rainfall from a channelled rock-surface is carried out as circumstances warrant, while artesian water is of immense value, especially in Queensland and New South Wales. Very noteworthy is the concentration of sheep in Central Queensland, round

Longreach, in the heart of the Great Artesian Basin. It should be remembered that the distribution of sheep depends not only upon the pasture available (itself varying with the rainfall), but also upon droving facilities and communications; it is important that railways should penetrate far into the pastoral areas. Absence of transport facilities militates against the opening up of such areas as the Bight littoral and large parts of the savanna belt.

Breeding has resulted in an enormous improvement in the average weight of the fleece. In 1877 it was 4 lb.; to-day it is about 7½ lb. In stud sheep a fleece of 30 lb. is often exceeded. The areas mainly occupied by the best breeds of merino lie on the inner slope of the Eastern Highlands of New South Wales and in the Riverina. Shearing, except on small holdings, is by machine, and itinerant bands of shearers move from station to station to assist in this work. It usually starts in early August in Queensland, while in Victoria it occurs in September or early October. The clip is sorted and packed in bales (pressed and bound with hoop iron) of about 350 lb. in weight. Camels, oxen, horses, barges, and lorries carry the wool to railhead or port. In 1927–28 the Australian wool clip was 888,000,000 lb., 25 per cent. of the total world production. In recent years some 17 or 18 per cent. of the production has been scoured and washed locally, but the bulk is exported in the 'greasy' state. In 1927 28 some 44,000,000 lb. were retained for manufacture.

Reference has already been made to the production of mutton and lamb, and a substantial export trade in frozen meat has been built up. Rather more important is the export of sheepskins, especially sheepskins with wool.

Other Animal Production. It may be convenient here to refer to certain types of animal production that are really aspects of the farmer's rather than the pastoralist's occupation. With about a million pigs, mainly in New South Wales, Victoria, and Queensland, Australia is normally able to meet her requirements in pig products, and to have a small surplus —chiefly bacon, ham, and lard—for export. The same is true with regard to poultry and eggs. Honey production is favoured by the flowering eucalypts and other flora, as well

as by the fact that there is no cold season, and there is a small export.

Of some 200,000 goats, chiefly in Queensland, a small proportion is of the angora type; some attention has been given to the production of mohair, but it is of no particular importance at present, although the physical conditions in many areas are not unfavourable. Small numbers of camels, mules, and donkeys provide supplementary transport, mostly in Western and South Australia, while there is an insignificant number of ostriches in South Australia.

In addition it may be worthy of mention that the ubiquitous rabbit is exported in the frozen state (3,500,000 pairs in 1927–28), while there is a considerable export trade in rabbit skins. Opossum, kangaroo, fox, wallaby, and other skins also figure in the export trade, the first being a substantial item.

Fisheries

Despite an abundance of fish, both fresh-water and sea-water, the fishing industry is largely undeveloped, and the value of the fish caught in Australian waters is exceeded by the import of fish, chiefly tinned salmon from North America and Norway. The total consumption of fish is not large. Of the fresh-water fish the Murray cod, which attains considerable size, is the best known, while in some rivers trout and other fish have been introduced.

In connexion with general sea-fisheries, mainly carried on by Greeks, it is of importance to remember the generally narrow continental shelf, which leads to a scarcity of good trawling areas. Research carried out by the Federal Government has disclosed good trawling-grounds off the coast of New South Wales, from Port Stephens to the neighbourhood of Cape Howe, east of Flinders Island in the Bass Strait, and in the middle of the Great Bight, half-way between Adelaide and Albany. Both the New South Wales and Queensland Governments have at different times undertaken trawling enterprises, and grounds have been charted off the coast of Southern Queensland. Some development of the trawling industry operating from Sydney has recently taken place.

The big population centred in Melbourne is served by only small local fisheries. The varieties of fish caught include schnapper, rock cod, whiting, flathead, mullet, flounder, barracoota, and spiny lobster, while oysters are plentiful in the shallow waters of many inlets and estuaries, chiefly of New South Wales and Queensland. Australia hardly participates at all in Antarctic whaling, though there is some local development in Western Australia.

FIG. 58. PEARLING LUGGERS—LOW TIDE
Roebuck Bay, Western Australia.
By courtesy of the Immigration Office, Commonwealth of Australia

Tropical Fisheries. It is convenient to include under this heading work in northern waters connected with pearls, trochus shell, *bêche-de-mer* (sea-cucumber or trepang), and tortoiseshell. The pearl oyster is found from Cape York to Shark Bay, and fishing particularly centres upon Thursday Island, off Cape York, and Broome, in Western Australia, the latter place being more important. Only a few areas along the coast are really favourable, and experiments have been made with cultivating the pearl oyster. About three hundred boats are engaged in the work, which is chiefly in

the hands of Asiatics, mostly Japanese, though the lugger-owners must be Europeans. Divers collect at depths generally of from four to ten fathoms, though profitable results can be obtained as deep as twenty fathoms, which, however, puts considerable strain on the diver. A Commission has come to the conclusion that 'white Australia' is not imperilled by the present conduct of the industry. The value of the pearls obtained seldom exceeds 20 per cent. of the value of the pearl shell; most pearls come from the Broome area, some being remarkably beautiful specimens.

Trochus shell (from a mollusc) is also collected; the quantities of *bêche-de-mer*, obtained, like tortoiseshell, from the coasts of Queensland and Northern Territory, seem to be declining. The collecting of these products is generally worked along with pearling.

The exports of these products were valued in 1927–28 as follows: pearl shell, £338,000, trochus shell, £76,000, tortoiseshell, £3000, *bêche-de-mer*, £15,000. The trochus shell goes mainly to Japan and the dried *bêche-de-mer* to China. The value of the pearls obtained was £23,000.

Agriculture

The increasing relative importance of agriculture in the economic activity of Australia is illustrated by the fact that whereas in 1913 the value of the exports of agricultural products was only about 25 per cent. of the value of the exports of pastoral products (excluding dairy and farmyard products), the proportion was about 44 per cent. in 1926–27 and about 37 per cent. in 1927–28.[1] For this the cultivation of wheat, which has made remarkable progress during this century, is mainly responsible.

The soils of the cultivated areas are generally of the red colour for which Australia is famous. In the plains the deep alluvium of the river-banks and the areas liable to flood have black soils not generally well suited to production of grain; elsewhere the red colour (due to oxide of iron) seems to be the result of long spells of dry weather, to which the land is

[1] There was a poor wheat harvest in 1927–28.

subject; there is an absence of humus, to which the action of white ants, which completely decompose the vegetation, largely contributes. There is a deficiency of phosphates in the soil, and it is not surprising that there is a large import of rock phosphates (from Nauru and the Gilbert and Ellice Islands), manufactured locally into superphosphates for use

FIG. 59. MALLEE, VICTORIA

Rolling down and burning off this growth has cleared much land for wheat-growing.

By courtesy of the Immigration Office, Commonwealth of Australia

on the land; smaller quantities of Chilean nitrates are also imported.

The rapid clearing of the land is an essential preliminary to the extensive type of cultivation employed in Australia. In many regions now devoted to wheat-growing, as in parts of South Australia and Western Australia, the problem has been met by killing the trees by ring-barking, the stumps being left in the ground. The mallee districts of South Australia and North-western Victoria (there is also some mallee country in New South Wales and Western Australia) were long neglected, because the matted growth of mallee

(a eucalypt adapted to low rainfall, with a size and growth similar to the lilac of this country) seemed to present an insoluble problem. The difficulty was met by simply rolling down the mallee with a heavy roller (frequently an extemporized roller made by filling a boiler with stones) and then burning off the broken stems, leaving the roots in the ground. The land under these conditions needs a special plough, and

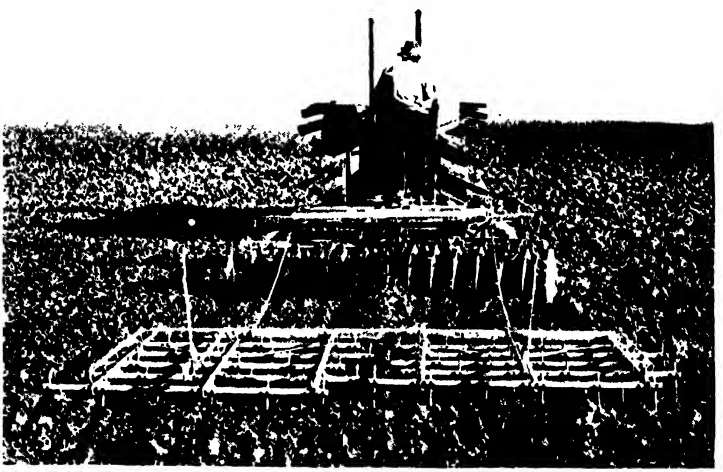

FIG. 60. DISKING AND HARROWING IN ONE OPERATION
Another example of labour-saving machinery. Note the extensive field.
By courtesy of the Immigration Office, Commonwealth of Australia

its cultivation was dependent upon the invention of the 'stump-jump' plough, which rides over obstacles it cannot break.

The methods are extensive, and a low average yield of wheat per acre goes with an enormous total yield, made possible only by the large-scale employment of machinery upon fields of considerable size, so that the available labour shall be most economically used. In this connexion the 'combined harvester,' another Australian invention, is worthy of mention. This machine cuts, threshes, and winnows the grain, and stores it in a bin from which it can be

directly bagged, at the rate of ten to twenty-five acres per day, according to the size of the machine. The combined harvester can only work under dry conditions such as obtain in much of Australia. The fields run up to three miles in length. On a 1000-acre farm which combines sheep-rearing with wheat-growing there may be, apart from the farmer and his family, only one or two men employed, except at times of special stress.

That wheat dominates the agriculture is illustrated by the proportion of the total cultivated area under this crop. In the year 1927–28, out of a total of over 19,000,000 acres under cultivation, nearly 64 per cent. was under wheat; hay and green forage accounted for 21 per cent., oats for nearly 6 per cent, barley for 1¾ per cent., and maize for 2 per cent.

Wheat. The following table, which needs consideration in the light of differing geographical conditions, brings out the position of wheat in the agricultural production of the several states:

WHEAT, 1927–28

STATE	ACREAGE IN THOUSANDS	PERCENTAGE OF TOTAL CULTIVATED AREA	YIELD IN BUSHELS PER ACRE
New South Wales .	3030	60·6	8·92
Victoria . . .	3064	62	8·54
Queensland . .	215	20·2	17·59
South Australia .	2941	70·2	8·16
Western Australia .	2099	80·6	12·12
Tasmania . .	29	0·9	26·25

The table shows (1) the relative importance of the different states and (2) the small wheat crop in Queensland and the insignificant one in Tasmania. That is to say, wheat is not very important in the state with only a limited area in temperate latitudes, nor in the state in which the climatic conditions approximate closest to those of Western Europe and in which the extensive type of farming is not favoured by the geographical conditions. The yield per acre, taking Australia as a whole, was 9·63 bushels—distinctly lower than

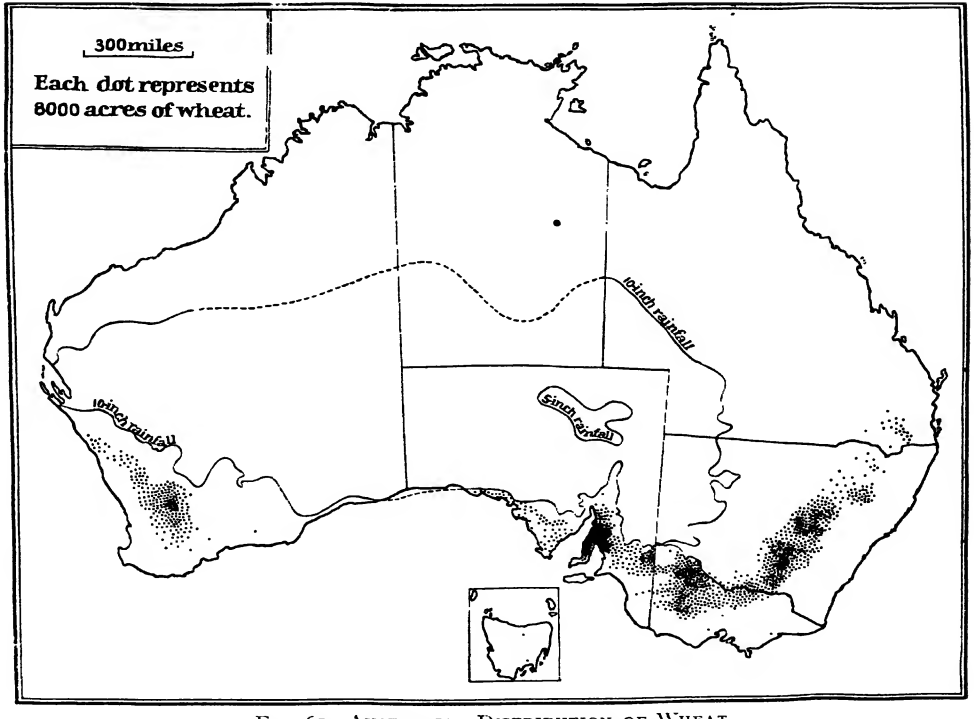

FIG. 61. AUSTRALIA—DISTRIBUTION OF WHEAT

The map is for 1924, since when there has been a great increase in the area under this crop, without, however, seriously affecting the general distribution. In some districts production is carried near to the 10-inch annual isohyet.

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usual, as the average for the preceding decade was 12·2 bushels -which compares with a yield of more than 30 bushels to the acre in England. It compares favourably, however, with the yield per acre in other parts of the world in which the extensive type of wheat-farming is carried on. The yield per acre in Tasmania is almost invariably higher than that in the other states; Tasmania is the only state in which the crop is a summer one; the rainfall is generally more reliable there, and the cultivation is more intensive in character.

The production fluctuates considerably. Thus in 1926–27 11,688,000 acres yielded 161,000,000 bushels, while in the next year 12,279,000 acres yielded 118,000,000 bushels, the yield per acre dropping from 13·75 bushels to 9·63 bushels.

The acreage under wheat continues to increase; in 1928–29 it covered 70 per cent. of the total cultivated area of 21,200,000 acres. New South Wales, Victoria, and South Australia have all shown in recent years a general advance in the area under wheat; Western Australia, however, has recorded the most remarkable change, having in 1927–28 more than twice the acreage of wheat she had in 1921 22.

The distribution of wheat is determined to a remarkable degree by the climatic conditions. On the mainland it is a winter crop, so that the distribution is determined primarily by the winter rainfall; harvesting takes place in January and February, and earlier farther north. It is true that the temperate coastal districts formerly grew a good deal of wheat, but this has been almost entirely abandoned since the opening up of the interior.[1]

The wheat belt of the mainland lies in the temperate latitudes; in the south-east it is situated on the inside of the Dividing Range, coming to the coast in the rift valley of South Australia and in the Eyre Peninsula. It may be followed from Warwick, in Queensland, through Tamworth, Bathurst, and Albury, into the Wimmera and mallee of the Lower Murray region; the area between the Lofty Range and the Spencer Gulf, including much of the Yorke Peninsula,

[1] Compare the decline of wheat-growing in Eastern Canada following the development of the prairie country.

is noteworthy for its heavy production. In Western Australia the bulk of the wheat is grown well inland, but it comes close to the coast in the neighbourhood of Geraldton. The winter rainfall, providing, as it does, for the growth of the crops, is the important climatic factor, and most of the wheat is grown between the 10-inch and 15-inch isohyets for the period April to October. In North-western Victoria

FIG. 62. THE STRIPPER OR COMBINED HARVESTER

Drawn by horse team or tractor, this provides a further example of labour-saving machinery. It strips off the ears in a broad swath, threshes the grain, and stores it in a large bin, from which it can be directly bagged. Such a machine can be used only under dry harvesting conditions.

By courtesy of the Immigration Office, Commonwealth of Australia

and much of South Australia the wheat belt comes near to the 10-inch annual isohyet, but only dry-farming methods permit this.

In areas such as the Wimmera district of Victoria and the mallee country, in which one year's rainfall would be insufficient, the method is to grow the crop on land that has been lying fallow; the surface during the fallow period is kept loose by being carefully worked as many as a dozen times during the year, so that the rainfall is conserved. In

this way the rainfall of considerably more than a year is available for the crop, and in the Wimmera yields of up to 30 bushels to the acre have been obtained by these methods. A three-year rotation is generally followed: fallow, wheat, barley. Only by these measures has it been possible to develop the dry north-west of Victoria, formerly regarded as waste land, as well as large parts of the wheat-growing areas of South Australia and Western Australia.

Wheat-breeding has played its part. Some 70 per cent. of the Australian crop is a variety known as Federation, a beardless wheat possessing a short stalk, which means less drain on the available moisture. The quality of the grain is high; it is of a hard, flinty character, and excellent for milling purposes. Whereas at the beginning of the century Australia only met her own requirements, there is now an enormous surplus of wheat and flour for export.

Oats. Next to wheat oats has the largest acreage, but it is not of great importance; in the year 1927–28 the oats acreage was only one-eleventh of that devoted to wheat, and only in Tasmania (which gives the largest yield per acre) is it a bigger crop, while in Queensland it is insignificant. Victoria is the largest producer, followed by Western Australia, South Australia, and New South Wales. It is used principally as a feed grain, and only a comparatively small proportion is turned into oatmeal.

Barley is a small crop. It is primarily grown in Victoria and South Australia for malting purposes, and the production is sufficient to render Australia independent of imported malt.

Although the climatic conditions of much of the continent favour the production of **maize**, especially along the eastern seaboard, where a high summer temperature is combined with adequate rainfall, the production is not large, although this is the third cereal in order of acreage. It is chiefly grown in the coastal districts of New South Wales and Southern Queensland, although the smaller area devoted to maize in Victoria gives the highest yield per acre, as there it is grown under particularly suitable conditions. The production, which is used principally for stock, has not usually in recent years

been sufficient to obviate the necessity for some import of maize; the labour question is a difficulty, and bigger production seems contingent upon the improvement of machinery for harvesting and threshing the crop.

For the cultivation of **rice** parts of the northern and eastern seaboards seem to have a suitable climate. A wild rice is indigenous to Northern Territory, and an experiment with

FIG. 63. RICE AT LEETON, MURRUMBIDGEE IRRIGATION AREA
A recent development in cultivation with white labour.
By courtesy of the Immigration Office, Commonwealth of Australia

upland rice showed that it could be successfully grown on the Daly river, while upland rice has been grown in the Cairns district of Queensland. Australian conditions, however, necessitate the maximum use of machinery, owing to labour difficulties, and in this connexion the history of rice-growing in the Murrumbidgee irrigation areas of New South Wales is interesting, for it is only here that rice is grown on a commercial scale. The existence of a good deal of heavy clay land not profitably farmed led in 1922 to experiments with American seed (earlier experiments with seed from India having failed), and there was a commercial planting

of 143 acres in 1924, giving a yield of rice stated to be superior to the imported article. Careful attention was given to the technical problems connected with pure seed, preparation and submergence of land, and the use of machinery; it was found feasible to adapt wheat machinery to harvesting operations. Behind an import duty on uncleaned rice of £3 14s. 8*d*. per ton the area had increased to 12,000 acres in 1927 28, chiefly in the Leeton district, and it is thought that there is sufficient available land for 20,000 acres to be cropped annually, which should more than meet the Australian demand. Second-grade rice has been found very suitable for stock when drought has led to a deficiency of other fodder. This fostering of rice-growing is an interesting example of State assistance to production.

Hay. It is only to be expected that the importance of pastoral occupations should necessitate a big production of hay. The area returned as under hay varies much from season to season; in 1927-28 it was 13·7 per cent. of the cropped area. Next to wheat, hay covers the largest acreage. It is of interest that practically none of the hay is made from grasses; most of it is wheaten or oaten hay, and the fluctuations in hay production are largely the result of the price outlook for grain; a crop may be left for grain if a heavy yield or a high price is in prospect, or it may be cut for hay if the outlook for grain is unsatisfactory. It is not surprising, therefore, that the distribution of hay largely follows that of wheat and oats, but it is noteworthy that wheaten hay dominates in New South Wales, South Australia, and Western Australia, and oaten hay in Victoria and Tasmania. In Tasmania the production of hay dominates the cultivation. Lucerne hay is of considerable importance, particularly in New South Wales and Queensland.

A good deal of **green forage** is cut, mainly in dairying districts—maize, millet, oats, barley, rye, rape, lucerne, and even sugar-cane; the normal production may be largely increased in seasons adverse to wheat. In relation to this a good deal of attention in recent years has been given, especially in Victoria and New South Wales, to the development of ensilage on farms. In connexion with the dairying

industry there has been a notable increase in the area devoted to sown grasses.

Sugar. The production of sugar-cane in Australia provides the outstanding example of a tropical plantation industry based upon white labour. Reference has already been made to the abolition of Kanaka labour, upon which the early industry was built up. The change to a purely European basis was made possible only by drastic State assistance.

Sugar-cane requires abundant moisture, high humidity, and a retentive alluvial or volcanic soil, or, if the soil is of a lighter character, frequent falls of rain. Nevertheless, its cultivation is possible over a considerable stretch of latitude. It is found in scattered areas in the coastal belt from Grafton, in New South Wales, where the mean monthly temperature ranges from 57° F. to 78° F., to Cairns, where the annual range is from 70° F. to 83° F. The hot and the rainy seasons coincide, but cultivation is most favourable where the heavier rainfall is found (generally in the districts in which the highlands come close to the coast); irrigation is desirable if the rainfall declines below 50 inches.

In 1863 Captain Louis Hope, "the father of the Queensland sugar industry," commenced the first serious planting near Brisbane, and four years later 2000 acres were under the crop. Cultivation spread southward into the adjacent part of New South Wales and northward to Bundaberg, Mackay, the Burdekin river, Innisfail, and Cairns. Difficulties arose over the variety grown. The Bourbon variety introduced from Mauritius was affected by rust, and replaced by the Rappoe (or Rose Bamboo) variety. In general the more northerly districts have developed and the more southerly ones have relatively declined. The production and sugar content vary with the variety, the soil, and the climatic conditions; the cane suffers in times of drought. Irrigation is practised in the drier districts, chiefly round Ayr, on the Burdekin, and Bundaberg, on the Burnett; wells are sunk, and the water distributed to the canes along ditches. The total area under sugar in 1927–28 was 291,000 acres, of which barely 17,000 acres were in New South Wales; in this state dairying development and other factors have militated

against the extension of sugar. In 1928-29 the total acreage reached 300,000. Not all the acreage is productive, as there is always a considerable quantity of young canes uncut. In the warmer districts the same canes can be cut for many

FIG. 64. AUSTRALIA—SUGAR-CANE CENTRES

Sugar cane is grown in scattered areas, situated almost entirely in the coastal belt with more than 40 inches of rain. The centres of largest production are Cairns, Mourilyan, Ingham, Ayr, Mackay, Bundaberg, and Maryborough.

years, but in the south fresh planting is necessary every three or four years. Climatically there is no reason why the sugar industry should not spread along the northern coasts, but there is little likelihood of this, the prevailing economic and labour conditions being a hindrance.

The State assisted the industry at first by bounties and later by a high duty upon and even prohibition of imports,

combined with State purchase of output at a high guaranteed price to the producers. The surplus production in recent years has been exported at a world price far below the cost of production. This help has been conditional upon the prohibition of coloured labour, and it is noteworthy that in recent years many Italians have been employed. Much

FIG. 65. WHITE WORKERS ON A SUGAR PLANTATION, MAROOCHY DISTRICT, QUEENSLAND

Photo E.N.A.

attention has been given to the technical aspects of improved cultivation, to the use of machinery, as well as to the utilization of the by-products of the crushing mills, molasses and crushed fibre. There are some forty mills, and the sugar yield in 1927–28 exceeded 500,000 tons.

Attempts have been made to encourage the cultivation of *sugar-beet*. The principal development has been at Maffra, in connexion with the Glenmaggie weir irrigation undertaking on the Macalister river, in Gippsland. In 1927–28 nearly 2500 acres were under sugar-beet; this area yielded 2352 tons of sugar, as well as beet pulp and molasses for stock-feeding.

Fruit. The climatic conditions of many parts of Australia favour and even encourage fruit-cultivation, including both tropical and temperate varieties. Excluding vineyards, the area under fruit in 1927–28 was 278,000 acres, the total value of the crops exceeding £9,000,000. Fruit-production is important in all states, but the type of fruit necessarily varies. Of leading importance is the apple crop, some half of the production coming from the hinterland of Launceston and Hobart, while the Bunbury district of Western Australia and the wheat belt of the south-east are also important. Pears and plums show a similar distribution, and small fruits are especially important in Tasmania. The rainfall is sufficient for orange-cultivation in the coastal districts of Queensland and New South Wales, where the Parramatta district is important. New South Wales dominates in this crop, which is also produced in irrigation districts and in the winter rain belt. Lemons, apricots, nectarines, and peaches are all a feature of irrigation areas, and there are orchards devoted to many miscellaneous fruits, such as figs, olives, and prunes. Pineapples closely follow sugar distribution, and in their production, as in that of bananas (favoured by an import duty), Queensland is necessarily the leading state. Mangoes and coconuts are other tropical cultivations, though not of particular importance; tropical fruit-production, while climatically possible, lacks labour-supply for development.

In irrigation areas and the winter rainfall belt the bright sunshine helps in the production of dried fruit; refrigeration has assisted the export trade in apples, and there is a considerable amount of fruit-preserving and canning.

Vineyards and Wine. Many areas in Australia are well suited to the vine, and irrigation has permitted its extended cultivation. It was early introduced into New South Wales, but South Australia is now the leading state in its cultivation, followed by Victoria. Tasmania is climatically unsuited to viticulture. There is but a small acreage in Queensland, and the industry has made little headway in Western Australia, where, although the climatic conditions are favourable, attention has been mainly directed to other occupations. The total area of vineyards in 1927–28 was 113,000 acres,

of which roughly half were in South Australia, more than one-third in Victoria, and one-ninth in New South Wales. The acreage is roughly twice that of the pre-War period, the increase being largely due to the attention given to the production of raisins and currants in irrigation districts. The foothills of the Lofty Range in South Australia bear large vineyards important for wine-production, though this

FIG. 60. IRRIGATING GRAPE VINES

By courtesy of the Immigration Office, Commonwealth of Australia

industry has suffered in the past from outbreaks of phylloxera, a difficulty met by the planting of resistant stocks. Irrigation districts have also taken up wine-production, notably the Murrumbidgee area in New South Wales.

Australia meets its local demand for table grapes, and, as the home market for wines is small, it has been necessary to give attention to the export trade. Here the difficulty has been to enter a luxury market occupied by old-established brands. A substantial Commonwealth bounty in 1924 on exported wines of specified strength (since varied several times in amount) led to a considerable increase in production,

which amounted to 17,300,000 gallons in 1927–28; some three-quarters came from South Australia (where Tanunda and Clare are important centres), the rest mainly from irrigation districts in Victoria and New South Wales, a small quantity from the Bunbury district of Western Australia, and an insignificant amount from Southern Queensland. In 1927–28 the wine export (chiefly to the United Kingdom and New Zealand) exceeded £1,000,000 in value. It seems likely

FIG. 67. DRYING SULTANAS, MILDURA, VICTORIA
Note the flat terrain of this irrigation district.
By courtesy of the Development and Migration Commission, Commonwealth of Australia

that production on this scale is greater than the oversea markets can absorb; exports have since declined.

Irrigation areas where the open-air drying of fruit may easily be carried out produce large quantities of raisins, sultanas, and currants. Among the more important centres may be mentioned Shepparton, Mildura, Wentworth, Renmark, and the Murrumbidgee irrigation area. The production has substantially increased in recent years, and the value of the export trade, which is mainly with the United Kingdom, was more than £1,500,000 in 1927–28.

Cotton. Cotton-production is of interest, if not of importance. The suitability of much of Australia for cotton-

growing is illustrated by the occurrence of wild cotton (of no economic value) in parts of Northern and Western Australia. Attempts were made early in the nineteenth century

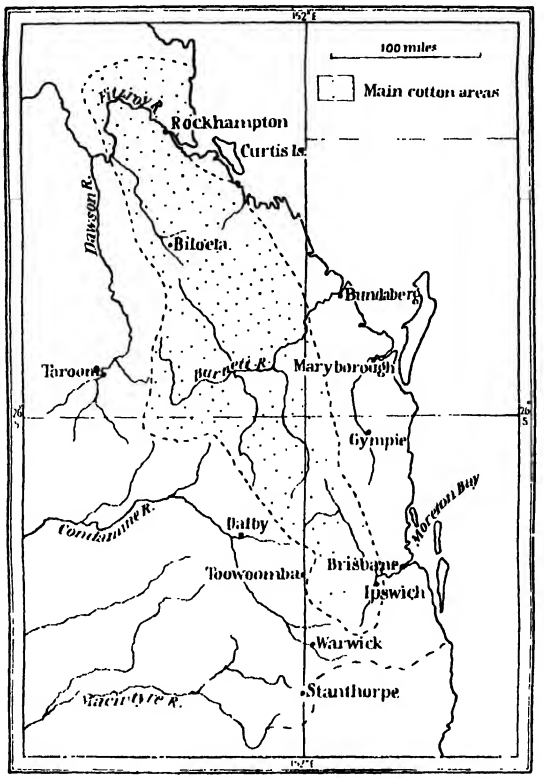

FIG. 68. THE CHIEF COTTON AREA OF QUEENSLAND

The map shows the region within which the bulk of the cotton is grown. At present the production is not large. There is a cotton research station at Biloela.

Based on a Queensland Government map

to introduce cotton into New South Wales, but the first notable experiment was at Brisbane in 1857; apart from later attempts to establish cotton-growing in New South Wales (notably at Grafton, on the Clarence river, in the north-east of the state), the important developments have taken place

in Queensland. The American Civil War gave a fillip to cotton-growing, especially in the Ipswich district; in the six years 1868–72 Queensland produced some 20,000 bales (of 500 lb.) of ginned cotton, but in 1891 only 30 bales; with slight fluctuations, the industry languished.

The difficulties of establishing cotton-growing are not primarily climatic (though rainfall variations are important

FIG. 69. WHITE WORKERS PICKING COTTON, DAWSON VALLEY, QUEENSLAND

By courtesy of the Immigration Office, Commonwealth of Australia

—the experimental station at Biloela, in Queensland, was severely handicapped in 1928 by drought during the planting season), but are chiefly connected with the scarcity of population, the costs of production on a white labour basis, the fluctuations in value of the crop, and transport and marketing facilities. Since 1920 the state Government and the Federal Government have both assisted cotton-growing; the latter at present grants, in addition to a duty on both imported raw cotton and yarns, a bounty on home-grown cotton, as well as a bounty to manufacturers using the home product. In Queensland, where six ginneries have been

established by the British-Australian Cotton Association, notably near Brisbane and at Rockhampton, 50,000 acres were harvested in 1924, but only 20,500 acres in 1928. The future of the industry is very uncertain.[1]

Of other crops **potatoes** is the most important. Victoria, Tasmania, and New South Wales (in this order) are the biggest producers, but the crop fluctuates, being very susceptible to drought. It is not of importance in the wheat belt. In some recent years there has been a considerable import, chiefly from New Zealand. Of other root crops **onions** is the most noteworthy; a small surplus is sometimes available. **Market-gardening** is carried on near the urban areas. **Tobacco** has received a good deal of attention, and serious attempts are now being made to establish a product for which there is a big local demand. **Hops** is a crop which has some importance in Tasmania, and has been noteworthy in Victoria, where, however, the production is now insignificant; as with tobacco, hops demand a supply of labour that is not easily available. For the same reason the possibilities of Queensland for tropical plantation development can hardly be exploited, though it has been demonstrated that rubber, oil-palm, and other products associated with hot, humid conditions could be grown; serious attempts have been made to grow **coffee**, but only 24 acres were recorded as under this crop in 1927–28.[2]

Minerals

The history of mining in Australia contains much that is romantic, as well as much of the greatest importance in the development of the continent. Reference has been made in an earlier chapter to the part played by gold in promoting population and settlement (p. 110), though this metal has now declined to comparative insignificance. The value of the gold won for some considerable time dominated the mineral output, but silver-lead production now normally

[1] See *Cotton-growing in Australia*, by R. Harding (1924).

[2] For a comprehensive discussion see "Agricultural Regions of Australia," by Griffith Taylor, in *Economic Geography*, April and July, 1930.

exceeds that of gold in value, though the yield of this has considerably varied. Copper is another metal the production of which has greatly fluctuated. In general metalliferous production has declined, and contrasts remarkably with the increases shown by the other primary occupations. The report of a Select Committee in 1922 gave a number of reasons for this decline, among which were the high costs of production and treatment of ores, the working-out of the more profitable known deposits, and the lack of new, valuable discoveries. Fluctuations in price also have their effect upon output. Nevertheless, Australia may be said to be rich in minerals, both metallic and non-metallic, for her resources include a variety of building-stones, limestone, oil-shale, precious stones, gypsum, salt, and other minerals of economic value. It must be remembered that large areas which may reasonably be expected to contain valuable deposits are little known, while the absence of large reserves of labour and remoteness from the seaboard of many mining districts contribute to high costs of production. The total value of mineral production in 1928 was nearly £22,500,000, for nearly half of which coal was responsible.

Old mining centres have closed down, as with Coolgardie, in Western Australia, or turned to other occupations, as with Ballarat and Bendigo, in Victoria, or Cobar and Wyalong, in New South Wales. Mount Morgan, in Queensland, described as "a mountain of copper capped with gold" (once the richest goldfield in the continent), has practically ceased production. Valuable discoveries have frequently been accidental, and apparently worthless country has proved rich. Sturt in 1845 commented on the desolate character of the Broken Hill district in New South Wales, later to become important for silver, lead, and zinc.

Gold. Production began in New South Wales and Victoria in 1851; the former state reached its maximum production the next year and the latter in 1856. Queensland started somewhat late, reaching a maximum in 1900. Western Australia made a late start—1886—and produced its largest output in 1903; in this year the total Commonwealth output was about £16,250,000 in value, to which Western Australia

contributed more than half. Neither South Australia (including Northern Territory) nor Tasmania has been a big producer. The maximum number of men employed in gold-mining was 70,000, in 1901; in 1928 it was 5686. In 1928 the total production was valued at £1,944,000, to which Western Australia contributed £1,602,000, Victoria £144,000, and Queensland and New South Wales about £55,000 each. It is clear that the interest of gold is mainly historical.[1]

Alluvial diggings have contributed largely to gold-production in the past, and the exploiting of goldfields has usually begun by washing or dry-blowing methods. To-day,

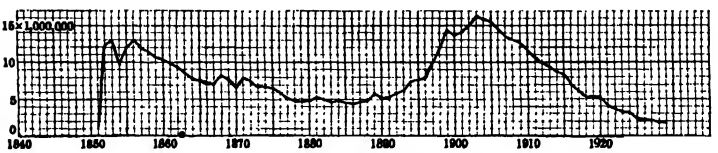

FIG. 70. AUSTRALIA GOLD PRODUCTION SINCE 1851

Each division represents £1,000,000.

Commonwealth "Year book"

although some gold is recovered by individual workers or by large-scale dredging and hydraulic sluicing operations at various places in Victoria and New South Wales, most gold is obtained by reef-mining. It must be remembered that Australia has no immense bed of gold-bearing conglomerate such as exists in the Rand, where, in fact, profitable gold-mining is based upon cheap labour.[2] Lodes of auriferous rock, usually quartz, have been deposited from hot solutions in earlier geological times in fissures or between the folds of the bedding of ancient sediments, and these reefs ('fissure reefs' or 'saddle reefs') are worked and treated by the cyanide process. Alluvial gold is, of course, found in sediments derived from the earlier denudation of auriferous rock.

A little gold is obtained in Tasmania, chiefly as a by-

[1] The output in 1929 showed a further decline in value to £1,807,400. To encourage greater production an Act has been passed providing, as from January 1, 1931, a bounty of £1 per fine ounce of gold produced in excess of the average annual production for the preceding three years.

[2] See the companion volume *Africa* (1929) in this series.

product of the Mount Lyell copper operations; in Queensland the Charters Towers and Mount Morgan fields are practically exhausted, and there is only a small production, chiefly from Ravenswood, Gympie, Mount Coolon, and Etheridge. New South Wales is still producing a little from scattered workings, including some from the old centre of Bathurst, although Cobar, once the biggest producer, now

FIG. 71. THE GOLDEN MILE, BOULDER KALGOORLIE DISTRICT, WESTERN AUSTRALIA

By courtesy of the Immigration Office, Commonwealth of Australia

yields only a negligible quantity. In Victoria, Beechworth, Bendigo, Castlemaine, Gippsland, and Ballarat are all producing districts; but the total dividend distributed by gold-mining companies operating in this state in 1927 was only £1000.

The south-west quadrant of Western Australia consists mainly of a granitic massif ribbed with outcrops of ancient metamorphic rock which trend generally from north-west to south-east. One belt may be followed from Cue, through Southern Cross, to Ravensthorpe, another from Meekatharra to the Coolgardie area. The gold is won principally by reef-

mining; the chief producing areas are the East Coolgardie field (three-quarters of the total production), with Kalgoorlie and Boulder, the Mount Margaret field, the Murchison field, and the Yilgarn field. Some is obtained in other districts, such as Dundas, Yalgoo, and Peak Hill, and a little from the more northerly Pilbara field. A new field at Wiluna is now being opened up. The water-supply of these goldfields, notably those of the Coolgardie area, often presents difficult problems.

Silver and Lead. The output and value of these ores have fluctuated considerably, largely as a result of price variations.

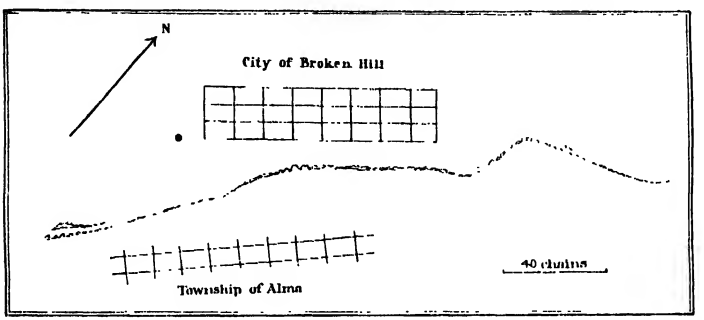

FIG. 72. OUTCROP OF THE BROKEN HILL LODE
From "Bulletin of the New South Wales Department of Mines" (Geological Survey)

Thus the value of the 1928 yield was less than half that of 1925, but it is of interest that the earlier phase of large-scale exploitation of the Broken Hill deposits caused the world prices of the metals to fall. This field, discovered in 1883, consists of a vertical lode standing out as a ridge among pre-Cambrian metamorphic rocks. It stretches for several miles, and varies in thickness from 10 to 400 feet. Some distance below the surface the ore consists mainly of carbonate of lead and kaolin, with silver, below which are sulphides of lead and zinc, with a high silver content. At first attention was concentrated upon the recovery of the silver, but the development of what is known as the flotation process for separating the sulphides permitted the treatment of huge dumps of residue and low-grade ores, so that the

making of lead and zinc concentrates assumed increasing importance. Little silver is now extracted locally; as it is chiefly associated with galena, it awaits extraction from the concentrates. Broken Hill, situated in mulga and saltbush country, is a considerable town, of more than 20,000 inhabitants (it had 30,000 in 1911); it was early connected by rail with Port Pirie, at which place the silver-lead concentrates are refined and from which the zinc concentrates are exported to Europe, Japan, and Risdon (in Tasmania) for

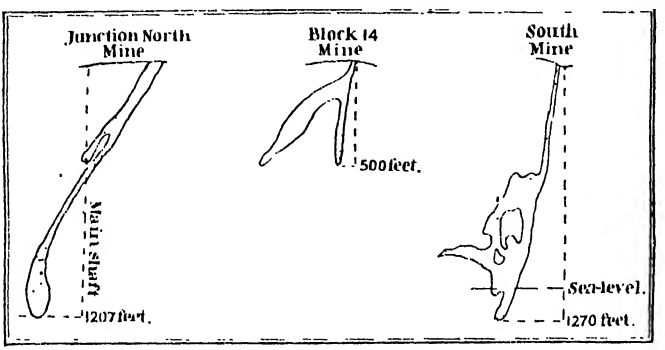

FIG. 73. SECTIONS ACROSS THE BROKEN HILL LODE

One at each end and one in the middle. The 'saddle-reef' formation—a ... which gold also often occurs—is well shown in the middle section.

From a "Bulletin of the New South Wales Department of Mines" (Geological Su...

treatment. Broken Hill is also now connected with Sydney *via* Menindee, on the Darling.

Elsewhere there is some silver-lead production in Queensland (greatly declined in the last few years), in the Chillagoe and Herberton districts. The Mount Isa field, near Cloncurry, is stated to be very rich, and is in the preliminary stages of development. Tasmania at present ranks second to New South Wales, producing silver and lead in one or two western and north-western districts and silver as a by-product from copper ore at Mount Lyell. Some silver and lead are obtained in Western Australia, where silver is a by-product in the goldfields and lead is worked in the Northampton district north of Geraldton, and there are insignificant quantities from Victoria, South Australia, and Northern Territory. Of

a total silver and lead production valued in 1928 at £2,687,000 New South Wales was responsible for £2,492,000 and Tasmania for £180,000. Increased production in New South Wales was responsible for an advance in the total value to £3,169,000 in 1929.

Zinc. Zinc concentrates from the Broken Hill district have been referred to above; the value of the export from this district in 1889 was £1000, while in 1926 it was £1,360,000. In Tasmania large zinc-lead deposits are known in the western division, where the Hercules-Rosebery mine produces both metals, and Risdon (near Hobart) smelts concentrates from oversea—chiefly from New South Wales; the value of the zinc production in 1928 was £1,307,000. The Mount Isa mineral field in Queensland is also said to be rich in zinc.

Copper. This mineral has had historic importance, especially in South Australia, which state, though producing little now, has yielded more than any other. The Commonwealth production was valued at nearly £5,000,000 in 1918, but at only £640,000 in 1928. High costs of production, together with low prices, have contributed to this decline, only Tasmania maintaining a steady output. Copper is widely distributed in New South Wales, but the Cobar area is no longer producing, and there is now only a small and intermittent production; the deposits largely consist of low-grade ores. In Queensland the Cloncurry district—richly cupriferous—has extraordinarily declined; a little comes from the Chillagoe area, and Mount Morgan is worked out. Famous copper centres in South Australia—Kapunda, Wallaroo, and Moonta—contribute a very small yield, and production in Western Australia has almost ceased. In Tasmania the whole production comes from Mount Lyell, which utilizes current from the Lake Margaret hydro-electric undertaking. In 1928, of the total copper-production, valued at £640,000, Tasmania was responsible for £445,000 and Queensland for £177,000. The total value in 1929 exceeded £1,000,000, mainly due to increased output in Tasmania.

Tin. Until quite recently tin production has been relatively well maintained, owing to a fairly high price-level. Tasmania is the largest producer, closely followed by New

South Wales, with a large contribution from Queensland. Lode-working and dredging methods are both employed. The chief Tasmanian production is from the Briseis, Endurance, Pioneer, and Mount Bischoff mines of the north-west corner. In New South Wales the chief production comes from the western slopes of the New England plateau (Tingha and Emmaville). In Queensland the producing districts are Herberton, Kangaroo Hills, Stanthorpe, and Chillagoe. A little comes from the Beechworth district of Victoria, from the Pilbara district of Western Australia, and from various places in Northern Territory. Of a total production valued at £664,000 in 1928 Tasmania yielded £260,000, New South Wales £232,000, and Queensland £135,000. The value of the total production declined in 1929 to £460,000.

Iron. Deposits of iron are scattered extensively through Australia, but inaccessibility, high production costs, and the low grade of much of the ore hinder development. At present Iron Knob, a famous hill west of Spencer Gulf, in South Australia, with an average iron content exceeding 63 per cent., is giving the principal output, a railway connecting the mine to the port of Whyalla. In 1927 nearly three-quarters of a million tons of ore were raised and sent to Newcastle for smelting. There are other big reserves of ore in the same district. Elsewhere the only production (except for small quantities of ironstone flux for the reduction of gold and copper ores) comes from the Lithgow district, for smelting in the iron-works there. Western Australia is said to have vast deposits of iron ore in many coastal districts from Cambridge Gulf to Cape Leeuwin, especially round King Sound and in the Yalgoo goldfield. Iron has been worked in Victoria and Tasmania; in the latter state the reserves of good ore are of great extent, especially in the Savage river basin, on the west coast. Attempts have been made to promote Australian production by subsidizing certain iron and steel products using local materials.

Other Metals. There is a trifling production in many districts of other metals, including platinum and rare metals such as cobalt and tungsten, used for special steels. They have, however, little significance since the Great War.

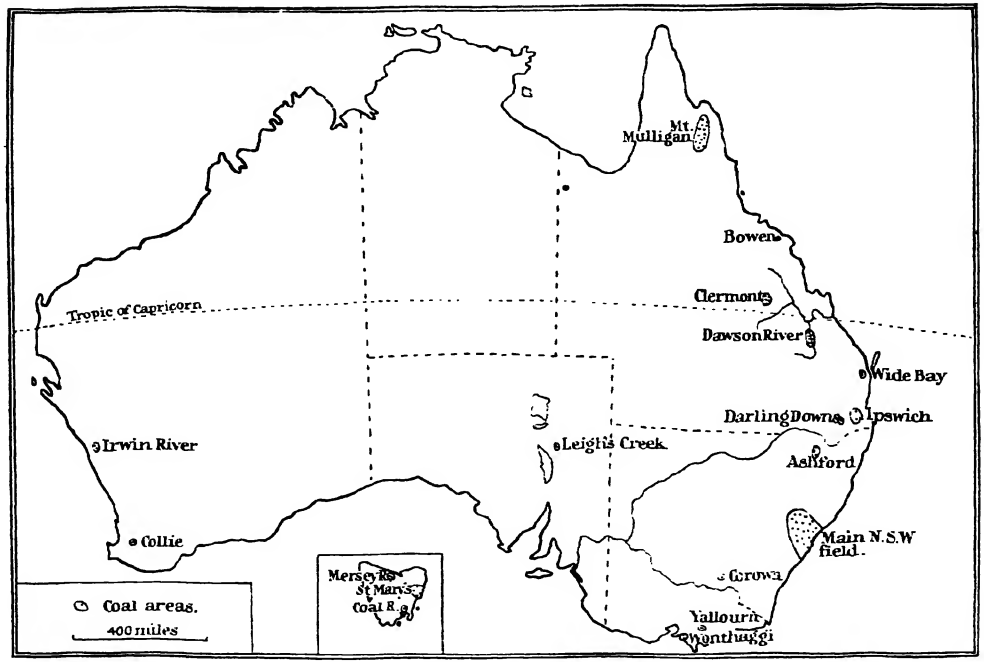

FIG. 74. AUSTRALIA—COAL BASINS

For the varying age of the deposits and for their productive importance see text.

Coal. Although lacking coal of Carboniferous age, Australia contains important coalfields somewhat less old (belonging to the Permo-Carboniferous period), as well as large reserves of coal of Secondary age and of Tertiary brown coal.

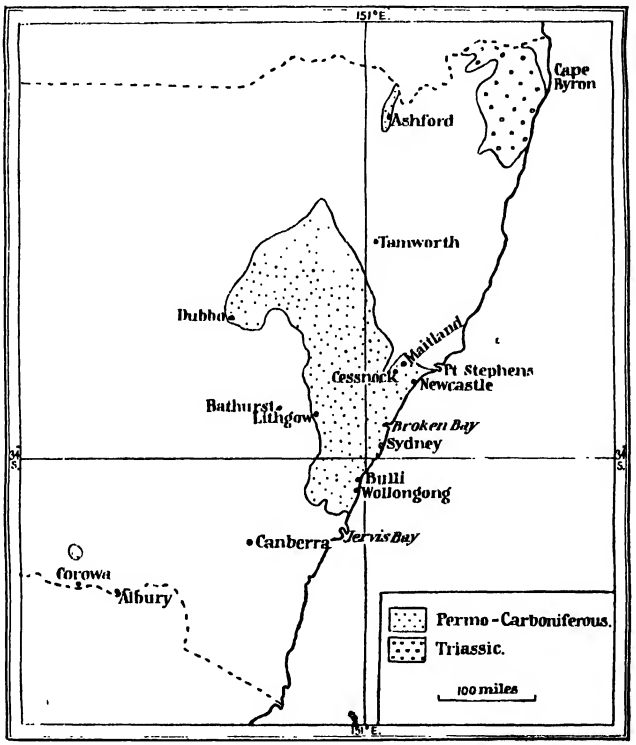

FIG. 75. THE COAL BASINS OF NEW SOUTH WALES

For development see text.

After a map in a "Bulletin of the New South Wales Department of Mines" (Geological Survey)

The New South Wales coalfield, underlying the Sydney area, is the most important in the Southern Hemisphere, and probably one of the richest in the world. The chief coal areas are associated with the Eastern Highlands, including Tasmania, but deposits are also known in South Australia and Western Australia. In recent years the whole production

(including the brown coal production of Victoria, which represents only a small fraction of the total) has considerably exceeded £10,000,000 in value, the yield of New South Wales generally being responsible for over 80 per cent. of this. In 1927 coal-mining employed 31,000 people, more than half the total engaged in mining work.

The chief coal basin—New South Wales contains, as it were, half the 'saucer'—extends along the coast from Port Stephens to Ulladulla and inland to Dubbo. The coal-measures themselves crop out at Newcastle and Maitland, in the Hunter valley, at Lithgow, in the Blue Mountains, and at Bulli, in the Illawarra district, while the uppermost

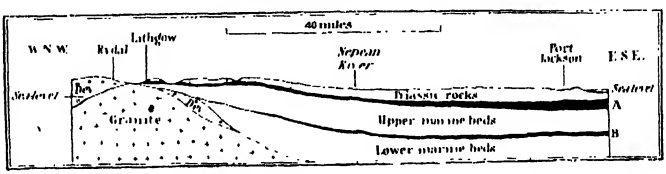

FIG. 70. SECTION ACROSS THE MAIN NEW SOUTH WALES COAL BASIN, FROM LITHGOW TO SYDNEY

A, Lithgow, Bulli, and Newcastle coal-measures; *B*, Greta and Clyde Vale coal-measures. Lithgow is about 3000 feet above sea-level.

After a section in a "Bulletin of the New South Wales Department of Mines" (Geological Survey)

seams have been worked at the Sydney Harbour Colliery, at a depth of 3000 feet. The coal worked in the Newcastle district is suitable for gas-making and household purposes, the Lithgow and Illawarra coals for steam, the latter also providing good coking coal. The most productive mines at present are between Maitland and Cessnock. The coal is chiefly used in factories, on the railways, and for bunkers and export, but there has recently been a prolonged stoppage arising out of high production costs.[1] In 1927, 11,126,000 tons were raised, of which only 1,688,000 tons were exported oversea (to New Zealand, the Philippines, Java, the Argentine, and to Pacific islands). Considerable quantities, however, were sent to other states of the Commonwealth (notably

[1] This was responsible for a decline in the value of the total Commonwealth production in 1929 to £8,675,000. The difficulties of the coal industry are analysed in *The Economics of Australian Coal*, by F. R. E. Mauldon (Melbourne, 1929).

Victoria). Coal is found at various other places in New South Wales, between this field and the Queensland border, as well as in the Corowa district, west of Albury.

Queensland ranks second in the production of coal, the principal output coming from the Triassic coalfield round Ipswich and on the adjacent Darling Downs. Similar coal is mined immediately behind Maryborough, while older coal-measures are worked in the Dawson valley south-west of Rockhampton, at Clermont, and behind Bowen; there is also some production in the Mount Mulligan (Chillagoe) area behind Cooktown. The total yield in 1927 was 1,100,000 tons. The black coal of Victoria is of Jurassic age, and is situated in the Wonthaggi district of Southern Gippsland; the output in 1927 was nearly 700,000 tons. Black coal and lignite have been proved in various parts of South Australia, but there is no exploitation. In Western Australia coal is known in several areas, and worked in the Collie district, in the south-west corner, where the Permo-Carboniferous seams contain a good deal of moisture; half a million tons were raised in 1927, and were largely used on the railways. Tasmania has coalfields of varying age; the chief production comes from the north-east, behind the port of St Mary's, and there is another field to the east of Hobart. An output of 112,000 tons in 1927 did not render the island self-supporting in coal.

The brown coal deposits, widespread in Victoria, have recently assumed importance. Situated chiefly in the Latrobe valley, in the eastern half of Gippsland, these deposits are very thick, constitute an enormous reserve, and can easily be worked by the open-cut method. The state Government is working it at Morwell and Yallourn, at the latter place in connexion with an enormous electricity enterprise. Though poor in heating power, the coal is so plentiful and accessible as to be economically used; the 1927 output was nearly 1,500,000 tons, mainly from the Yallourn mine.

Other Minerals. Oil-shale (kerosene oil, cannel coal) has been worked on a small scale in various parts of New South Wales, and is stated to be plentiful in Tasmania, but the production is insignificant. An attempt is now being made

to develop the oil-shale deposits at Newnes, New South Wales. Much searching for oil has been undertaken, without commercial success, in Queensland, Northern Territory, and the Kimberley district of Western Australia. Deposits occur of many widely different minerals, such as phosphate rock, asbestos, graphite, and mica, but the exploitation is negligible, because of high production costs and transport difficulties. Gypsum and salt are worthy of mention; the

FIG. 77. SALT LAKE, BOGA DISTRICT, NORTH-WEST VICTORIA
Salt-refinery on the edge of the lake.
By courtesy of the Immigration Office, Commonwealth of Australia

former is associated with salt lakes of arid districts, and is chiefly raised in the Yorke Peninsula of South Australia, but big deposits are also available in Western Australia. Salt-production is associated with salt lakes in Western Victoria and in the Yorke Peninsula and rift valley of South Australia, as well as with the evaporation of sea-water at the head of the Spencer and St Vincent Gulfs and along the coast of Western Australia, as at Rottnest Island and near Port Gregory.

Small quantities of precious stones are recovered, generally from alluvial deposits. Opals have had some importance in New South Wales, principally at White Cliffs, some distance north-east of Broken Hill. They are plentiful in the Stuart

Range, south-west of Lake Eyre, and farther north in the Macdonnells.

Manufactures

Reference has been made in the previous chapter to the development of manufacturing industry and to the importance it now has in the economic life. Since 1864, when Victoria initiated a protective tariff, this instrument has been increasingly used to foster secondary industries, and since federation the bounty system has been utilized to assist the development of selected manufactures. The Great War gave a fillip to many industries, notably to iron and steel, textiles, and certain metal trades, such as those connected with the extraction of the metals from the ores of the Broken Hill district, and British and other oversea firms have been encouraged to set up factories in Australia. Nevertheless, though the range of manufacturing industry is very large, and includes the treatment of many primary products, such as wheat, wool, metals, fruit, and timber, as well as the production of such things as motor bodies and accessories, tyres, gramophone records, pianos, matches, and fertilizers, Australia is still a large market for manufactured goods.

It is not surprising that the dominating manufacturing states should be New South Wales and Victoria; these two have between them three-quarters of the factory workers, though containing substantially less than three-quarters of the total population. The capital cities encourage the development of a variety of manufactures, to meet the demands of a population with a high standard of living, though big industrial enterprises are not necessarily associated with the metropolitan areas. Of the nineteen classes of industry listed in the Commonwealth statistics there is no single one in which either New South Wales or Victoria does not lead in the number of people employed. The most important categories are "clothing and textile fabrics," in which Victoria takes the lead, and "metal works, machinery, etc.," in which New South Wales has first place.[1]

[1] These two categories cover nearly half the persons classified as working in factories, who totalled 464,000 in 1927-28.

Next in importance is the class "connected with food and drink, etc.," followed by "books, paper, printing, and engraving," "working in wood," and "vehicles and fittings, saddlery and harness, etc." These illustrate some of the more important aspects of Australian industry.

In this section reference will be made only to some of the more important aspects of manufacture. Comment has been made in this chapter upon the mills and factories that have arisen in connexion with certain primary products—creameries, factories for drying and canning fruit, sugar- and timber-mills, and the like. The list may be considerably extended; there are refrigerators and soap factories at the ports dealing with meat, tanneries and wool-scouring and fell-mongering factories and flour-mills at most of the large ports. The metropolitan cities (especially Sydney and Melbourne) and their suburbs have many varied industries, often only on a small scale, such as leather, boot, and shoe making, brewing and distilling, tobacco-manufacture, and factories dealing with both necessities and luxuries.

Iron-smelting is carried on principally at Newcastle and Lithgow, though a big modern plant is being erected at Port Kembla to take advantage of the good coking coal of the Illawarra district. A heavy iron industry is carried on at Newcastle, covering structural steel, rails, and the like, and there is a big range of by-products, as well as a considerable manufacture of wire-netting, immense quantities of which are used in the enclosure of the pastoral and other properties and for defence against the rabbit. Other iron and steel factories are located at Lithgow and Port Kembla, in New South Wales, and at Castlemaine and Melbourne, in Victoria. An important aspect of the engineering industry is the manufacture of agricultural implements; the famous stripper-harvester, for example, is manufactured at Sunshine, a suburb of Melbourne. Each state has railway workshops, those of Victoria at Newport, a suburb of Melbourne, and of Chullora, near Sydney, being very extensive. Railway extensions, irrigation works, bridges (*e.g.*, the new Sydney Harbour Bridge) have greatly helped the iron industry.

Textile industries are mainly connected with wool, and

although the home consumption of this is increasing there is still a large volume of manufactured imports. There are woollen mills at Sydney, Albury, Goulburn, and Orange, in New South Wales, and at Melbourne, Geelong, Williamstown, Castlemaine, and Ballarat, in New South Wales. Australia aims at becoming independent of oversea supplies

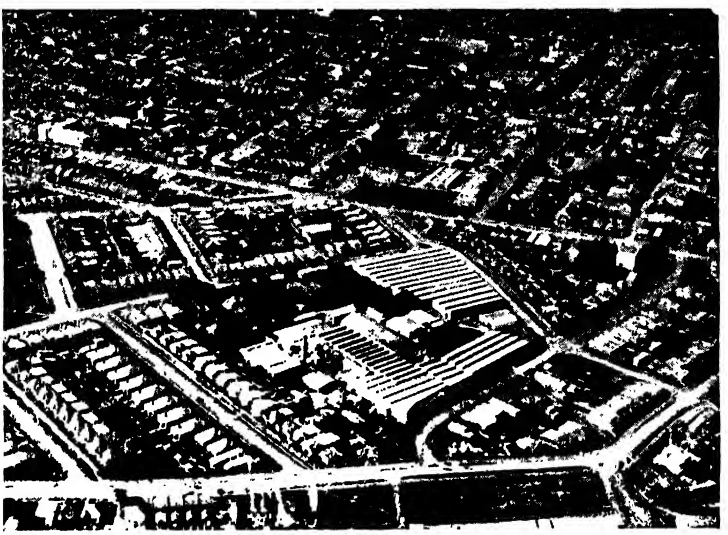

FIG. 78. WOOLLEN MILLS
At Marrickville, an industrial suburb of Sydney.
By courtesy of the Immigration Office, Commonwealth of Australia

of yarn, cloth, hosiery, and knitted goods. Attempts have been made to establish a cotton-spinning industry; this is in its very early stages. It has recently been recommended that the bounty on the use of Australian raw cotton should be extended and increased duties on imported yarns be imposed.

It is obviously difficult for a young country to establish manufactures that demand a high degree of skill, owing to the inadequate supply of necessary labour; nevertheless, Australia is determined to travel the road that will lead as

near as possible to the goal of independence of oversea supplies of essential manufactured goods. The experience of the Great War, when relative isolation from oversea sources of supply led to shortage and high prices, confirmed the Commonwealth in this policy.

CHAPTER V

AUSTRALIA: THE POLITICAL DIVISIONS

THE following table shows the area and population—exclusive of full-blood aboriginals—of the political divisions that comprise the Commonwealth:

STATE	AREA IN SQUARE MILES	POPULATION		DENSITY PER SQUARE MILE	POPULATION OF CAPITAL CITY,
		DEC. 31, 1900	MARCH 31, 1930		DEC. 31, 1929
New South Wales	309,432	1,360,305	2,483,615	8·11	1,238,660
Victoria	87,884	1,196,213	1,783,649	20·29	1,018,200
Queensland	670,500	493,847	934,643	1·40	318,631
South Australia	380,070	357,250	580,249	1·53	324,898
Western Australia	975,920	179,067	417,423	0·43	202,888
Tasmania	26,215	172,900	215,969	8·24	57,500
Northern Territory	523,620	4,857	4,584	0·01	—
Federal Territory	940	—	9,045	9·62	6,878[1]
Totals	2,974,581	3,765,339	6,429,207	2·16	3,167,655

The above figures show a considerable increase in population in each state since the beginning of the century, the increase being most marked in Western Australia, where the goldfield development was late. It is a reflection of the pioneering character of much of the settlement that in all states except Victoria and Tasmania there is a slight excess of males over females, which over the whole continent gives a population of about 104 males to 100 females. Apart from the decrease in Northern Territory, it is noteworthy that Tasmania has shown a slight decline since the Great War, emigration being in excess of the natural increase plus immigration. A similar tendency has recently been in evidence in South Australia. The average density per square mile

[1] June 30, 1929.

should be treated with caution, for the states differ widely in their proportions of land which under existing conditions are reasonably habitable. The relatively close settlement of Victoria is significant, while it is of interest that, if the populations of the capital cities be excluded, the mean density for the continent is little more than 1 person per square mile.

QUEENSLAND

Queensland ranks second in area and third in population. In the west it reaches the meridian of longitude 138° E.; in the south the boundary is the parallel of latitude 29° S., part of the Upper Darling, and the Macpherson Range, stretching to Point Danger. As some 54 per cent. of the area is north of the Tropic of Capricorn, and this includes the wettest part of the continent, the development has some distinctive characters; the more temperate south-east corner, however, is very similar to the adjacent part of New South Wales.

After the abandonment in 1842 of the early Moreton Bay penal settlement squatting developed considerably round the Brisbane river and on the Darling Downs, but when separation from New South Wales was secured in 1859 the population was only about 20,000. Later, attempts to develop cotton and sugar plantations on Kanaka labour introduced a serious domestic problem, and the opening up of the goldfields between 1867 and 1881 at such places as Gympie, Charters Towers, the Palmer area, and Mount Morgan brought big accessions of population. The use of artesian bores in connexion with stock-rearing beyond the so-called Great Dividing Range, or Eastern Highlands, gave considerable stability, especially to sheep-rearing in the interior, and a policy of railway development from a string of ports along the coast was pursued, to give access to interior pastoral and mining centres. It is noteworthy that other states have based railway development mainly upon their capital cities; the proportion of Queensland's population concentrated in its capital is smaller than that of any other state except Tasmania, partly because this method has not been followed.

Nevertheless, great tracts in the interior and west are either empty or possess a very scanty population. There are nearly 18,000 aboriginals and half-castes, mainly in northern districts and on Palm Island and the islands of the Torres Strait.

Physical Features. The Eastern Highlands are connected with the Western Plateau by the low Kynuna Upland and the Selwyn Upland, which merges into the Barkly Tableland on the western border about latitude 20° S. Structurally, apart from the two last-mentioned features, which are eastward extensions of the ancient western peneplain, the state contains large areas of the Great Artesian Basin and the Eastern Highlands. The boundary between these two may be followed from the Gilbert river (draining to the Gulf of Carpentaria), along the western edge of the Eastern Highlands, to Roma, whence it curves eastward and southward, to cut through the middle of the Darling Downs. The Artesian Basin consists of plains—somewhat elevated near the Eastern Highlands, where they reach over 1000 feet—draining by the Mitchell, Gilbert, Flinders, and other perennial rivers to the gulf, by Eyre Creek, Cooper's Creek, and various intermittent rivers toward Lake Eyre, and by the Condamine and Macintyre among upper tributaries of the Darling. Several ridges of old rocks, such as the Beal, McGregor, and Grey Ranges, crop out in the south-west corner. The gulf coast is unindented and flat and largely alluvial, and the rivers, though permanent, are very low in the dry season, when the sea flows up them for considerable distances.

The Eastern Highlands are a wide belt of warped and faulted upland and plateau, with a good deal of granite, notably in the Clarke Range, and large areas of basalt, as in the Eastern Highlands west of the Burdekin, the Buckland Plateau, and the eastern half of the Darling Downs, where a number of Tertiary cones constitute the Glasshouse Mountains. The most outstanding feature is the Atherton Plateau, rising steeply behind Cairns and Innisfail, where Mount Bartle Frere reaches 5438 feet and Mount Bellenden Ker also exceeds 5000 feet. The coastal lowland is narrow, but active

streams, fed by heavy rainfall, dissect the highland, causing deep gorges and fine scenery in the northern half (such as

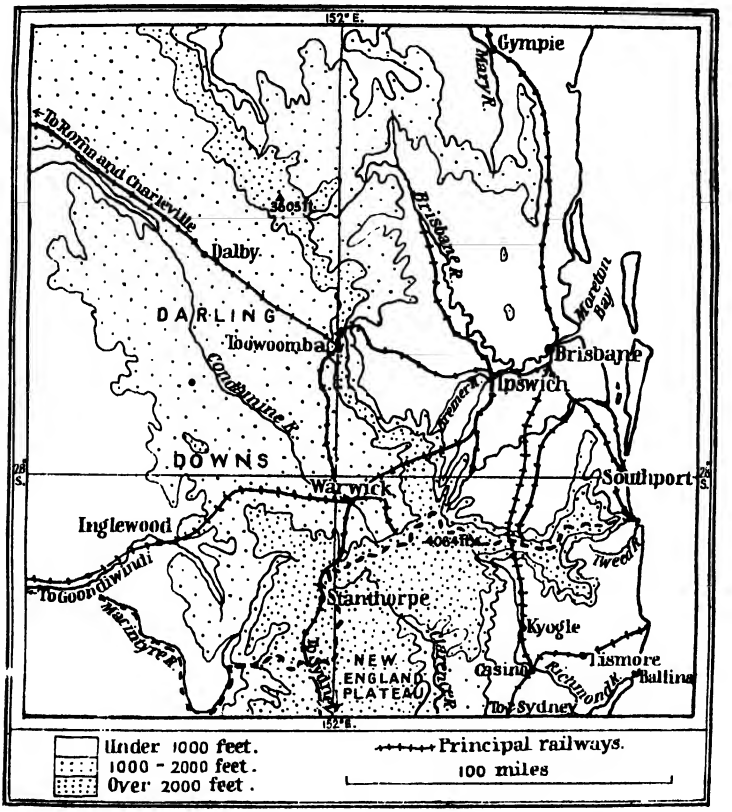

FIG. 79. BRISBANE, IPSWICH, AND THE DARLING DOWNS

Note the steep escarpment overlooking the basin of the Brisbane river. The new railway from South Brisbane to Kyogle tunnels under the Macpherson Range; of standard gauge like the New South Wales system, it is part of the scheme for linking the state capitals by uniform gauge.

the famous falls on the Barron river, near Cairns, which drop over 800 feet) and wide, long valleys in the southern half. Most noteworthy are the stretches of lowland along the Fitzroy river (with its tributary the Dawson) and the

Brisbane river; farther north the largest river is the Burdekin, with its tributary the Belyando. There is much recent alluvium along the rivers and the coast, but the only actual delta is that of the Burdekin.

The Great Barrier Reef. This, the greatest coral reef area in the world, is perhaps better described as a series of reefs. The outer reef starts at Bramble Bay, some fifty miles south of the Fly delta, in New Guinea, and stretches along what

FIG. 80. YOUNG MANGROVES COLONIZING A CAY, HOPE ISLANDS
The Hope Islands lie near to the coast, a little south of Cooktown.
Photo by M. A. Spender and J. A. Steers, Great Barrier Reef Expedition

was probably the Pleistocene coastline as far south as Sandy Cape. The Queensland coast here is marked by extensive fracturing, and although there has probably been some recent elevation, there is plentiful evidence of subsidence in later Tertiary times, and recent scientific work on the Reef supports in general Darwin's hypothesis of reef-formation. The outer reef, actively growing on its steep ocean side, is only about twenty miles distant from the mainland off Cape Melville, but reaches a maximum of about 150 miles farther south; it varies greatly in width, and consists essentially of sections several miles long separated by channels, except in

the south, where it becomes small scattered clusters. The channel between the reef and the coast is shallow, from 10 to 25 fathoms in depth, though toward the south it may be as deep as 60 fathoms. It is marked by numerous small reefs and islands; the islands near the coast—generally heavily forested—are high, isolated fragments of the Eastern Highlands, while the others are low coralline islands (cays), upon many of which mangroves, casuarinas, pandanus, and other salt-loving vegetation grows. Brightly coloured fish, clams, sea-urchins, oysters, trochus, sponges, *bêche-de-mer*, and turtles abound.

The channel, often referred to as the Grand Canal, though generally smooth, has certain disadvantages. The northern half in particular is rather difficult to navigate, and is liable to hurricanes, while the coast is dangerous, and narrow passages experience very strong tides.[1]

Climate and Vegetation. Brisbane, situated in the coolest corner of the state, has a mean annual temperature of 69° F. and a range of 18·5° F. (from 58·5° F. in July to 77° F. in January). Apart from modifications due to altitude, most of Queensland reaches a mean temperature of over 80° F. in January, and in July exceeds 56° F.; annual ranges in the northern coastal districts are small, but in the arid south-west, where daily ranges are also considerable, reach 30° F. Snow is unknown, except rarely in the more elevated portions of the south-east, where night frosts may be experienced for from five to seven months. The principal rainfall is brought by the summer monsoon, which blows from the north in the Cape York Peninsula and from the north-east in the southern part of the state. The heaviest rainfall is coastal, but the totals at different stations are affected by exposure and by the nearness and height of the highlands. The largest totals are found between Cairns and Cardwell, where a strip of coast receives over 80 inches. The following variations are noteworthy at places from north to south: Cape York (69 inches), Innisfail (144 inches),

[1] For a recent description and discussion see "The Queensland Coast and the Great Barrier Reefs," by J. A. Steers, in *The Geographical Journal*, September and October, 1929.

Townsville (47 inches), Bowen (40 inches), Mackay (67·5 inches), Rockhampton (39 inches), Brisbane (45 inches). Broadly speaking, the rainfall declines rapidly away from the east coast, as is shown by Charters Towers (25·5 inches) and Warwick (28 inches), and farther inland by Charleville (20·5 inches) and Longreach (17·5 inches), while Oontoo, where Cooper's Creek leaves Queensland, has only 5·5 inches. The Carpentaria coast is not excessively wet; Normanton has 39 inches, and Cloncurry, farther inland, has 19·5 inches. About one-seventh of the state—in the south-west—has an annual rainfall of less than 10 inches. The winter is generally dry, though the Innisfail coastal district receives a considerable amount of rain from the south-east trades and there is an appreciable amount in the south-east quadrant. The rainfall variations from year to year are very great, even in the coastal districts; thus Brisbane had only 19·4 inches in 1919, as against 62 inches in 1927.

The natural vegetation includes an eastern coastal strip of thick forest, largely tropical softwood brush forests of the equatorial type, as in the Cairns district and in areas farther south, or of hardwood eucalypts. Inside this and in the north is a belt of eucalypt forest with much grass; this gives way to savanna, with a considerable growth of brigalow acacia, while in the south-west the vegetation degenerates to mulga scrub and saltbush.

Development. Though potentially rich, Queensland is still very immature in development. The most closely settled area is in the relatively temperate south-east corner; elsewhere settlement is mainly along the east coast, with a thinner population in the pastoral districts; the Cape York Peninsula and the arid south-west are notably deficient in population. Even in timber, in which the eastern areas are relatively rich, the principal output comes from eucalypt forests of the Darling Downs and Gympie districts and the Macpherson Range. Some 200 of the 250 sawmills are in this part of the state. The production of red cedar, a tropical softwood prominent in the Cairns district, has declined to small proportions through extensive cutting in the past. Other soft timbers cut include certain pines—kauri, cypress,

hoop and bunya pines. There is some import of soft timber from North America. Considerable attention is now given to conservation and reafforestation. The value of the native sawn timber produced, including a considerable quantity of railway-sleepers, reached in 1927–28 nearly £2,000,000.

Owing to drought the number of cattle (including dairy cows) in Queensland declined from nearly 6,500,000 in 1924 to 5,128,000 at the end of 1928, though the proportion—nearly half the Australian total—did not materially alter. Nevertheless, during this period there was a steady increase in the number of dairy cows, and it is in this state that dairying has made the greatest progress in recent years. The chief dairying districts are necessarily along the eastern margins, and include the lowlands and tablelands behind Brisbane, Maryborough, and Rockhampton, but a recent feature has been the progress made farther north, in the neighbourhood of Townsville, Cairns, and Cooktown. Butter and cheese are extensively made, and much is exported; condensed milk is also manufactured.

Artesian water has special importance in Queensland. In June 1929 there were 1422 flowing bores, yielding 305,000,000 gallons of water a day, and 1825 bores yielding supplies by pumping, besides a large number of bores out of commission for various reasons. There has been a steady decline in the yield of water from this source; thus the region between Cloncurry and Winton has ceased to be a flowing area. There is urgent need for careful conservation of this important resource, in spite of recent evidence, especially in the drier south-west, that the rate of the decline is less than formerly. The distribution of artesian bores shows a much more intimate relation with sheep than with cattle.

Cattle-stations are found all over the state. They are least numerous in the Cape York Peninsula and most numerous in the south and coastal districts. The largest cattle-stations are in the coastal districts in the north-west, by the Gulf of Carpentaria, notably in the Normanton, Flinders river, and Barkly Tableland districts. There are twelve meat-works in the state, including five in the Brisbane district, two at Townsville, and one at Rockhampton, while in 1927–28 meat

to the value of £2,300,000 was exported, together with large quantities of hides and tallow.

Sheep numbered 18,500,000 at the end of 1928; Queensland is thus second to New South Wales as a sheep-rearing state, though it has little more than one-third of the latter's total of these animals. They are mainly west of the highlands, particularly in the middle of the artesian basin, round Longreach. The gulf and Cape York country has few. The flocks are remarkably free from disease. Extensive squatting is still the rule, and one sheep-run covers 5000 square miles. Cross-bred sheep (only 2 per cent. of the total) are chiefly found on the Darling Downs, where mixed farming is making rapid strides. The wool export was valued at nearly £10,000,000 in 1927 28, but there is at present a negligible export of mutton.

Horse-breeding has naturally considerable importance, and there is an export of horses to the countries of South-east Asia. Pig-breeding as an adjunct to dairy-farming is growing, and several bacon factories exist.

Some 125 boats are engaged in pearl and *bêche-de-mer* fishing, operating mainly between Thursday Island and Mackay. In 1928 the value of the pearl shell obtained was £162,000 and of the trepang £16,500.

The latitude and varying elevation of the state permit a wide variety of crops. Owing to its dependence upon winter rain, wheat, chiefly grown in the Darling Downs district and to a lesser extent in the Maranoa district to the west, has not the importance it has in other states, but it is tending to receive more attention as an element in mixed farming. In some years Queensland has imported wheat. Maize normally covers a larger acreage, and is mostly grown in the coastal districts south of the tropic, although it is also grown on the Darling Downs and is becoming important on the Atherton Plateau. These and other grains, besides being grown for milling, are produced to some extent for fodder, together with lucerne.

The leading agricultural product is sugar, the production and treatment of which employs some 30,000 people. In 1927–28, 212,000 acres of rich valley lands gave a yield of

nearly half a million tons of raw sugar; the yield was substantially exceeded during the following year, and more than a third of the production is surplus to Australian requirements. The favourable hot, humid conditions north of Townsville have led to the area between that point and

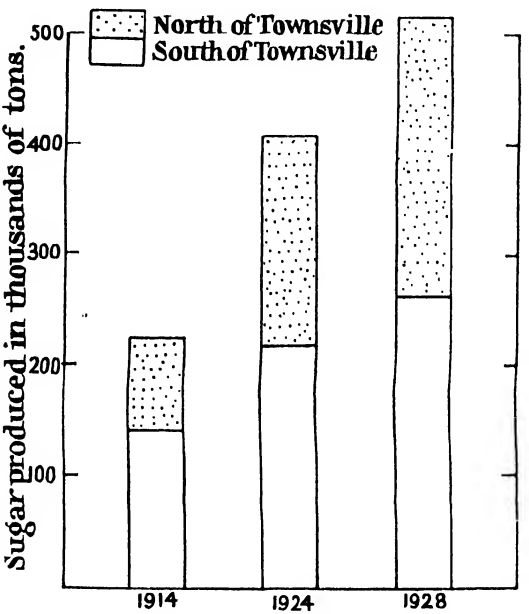

FIG. 81. QUEENSLAND SUGAR PRODUCTION

The production has fluctuated considerably, but the years selected are representative of the great increase in recent years and of the great progress made in the more northerly and therefore hotter districts.

From a Queensland Government Report

Cooktown receiving much more attention, and now about half Queensland's yield comes from this belt. Sugar-growing is often combined with dairying in the southern districts, and the holdings are generally small. North of Townsville drought is almost unknown, south of it irrigation is sometimes necessary; the state has a small pumping irrigation scheme on the Burdekin near Ayr (the Inkerman district), mainly subserving the production of sugar. The industry

is being carefully and scientifically fostered by the state Government; there are thirty-five crushing mills and two refineries.

The acreage under cotton has fluctuated considerably since the revival of the industry in 1920 by means of state-guaranteed prices, later replaced by a bounty. Thus the acreages harvested in 1921, 1924, and 1928 were respectively 2000, 50,000, and 20,500 acre... The main cotton areas, avoiding the wetter coastal district, lie between Ipswich and St Lawrence, east of the Eastern Highlands. Cultivation centres in the valley of the Callide, a right-bank tributary of the Dawson. The American upland type of cotton is grown. The yield in 1928 was 12,250,000 lb. of cotton, which was ginned at Rockhampton and Whinstanes (Brisbane), and mainly exported. There is little indication at present that Queensland will make a significant contribution to the world's cotton-supplies.

The Dawson valley irrigation scheme is of interest in this connexion. An enormous dam is proposed at Nathan's Gorge, thirty miles below Taroom, to impound 2,500,000 acre-feet of water, to irrigate about 200,000 acres. It is probable that the scheme will include a power-station, but the whole work is in its preliminary stages. A minor portion of the scheme—a weir at Theodore, lower down the river—is complete, and some 300 farms have been occupied. Maize-growing and dairying are undertaken, but the settlers have so far chiefly relied on cotton. This at present is a small-scale enterprise, but it is hoped to develop the valley on the basis of irrigation, combined with the farming of the lands beyond the reach of the artificial water-supply.

Many fruits are cultivated. The eastern coastal districts yield large quantities of bananas and pineapples; oranges and mangoes are also grown. Deciduous fruits do well on the uplands of the south-east, and the vine and citrus fruits are cultivated, as in the neighbourhood of Roma. Other vegetable products which have interest but not importance include tobacco, coffee, millet, arrowroot, and ground-nuts.

Mineral production, apart from coal, copper, and tin, is not

now of much importance. Mining in 1928 employed rather more than 5200 men, nearly 2700 of whom were engaged in coal-mining. Gold-production declined in 1929 to a value of £33,000. Copper-production, chiefly from Cloncurry, was valued at £271,000 in 1929. Silver-lead, once important, is worked a little at Chillagoe, and a rich field, associated with zinc, as in the Broken Hill lode, is about to be opened at

FIG. 82. PINEAPPLE PLANTATION, QUEENSLAND

By courtesy of the Development and Migration Commission, Commonwealth of Australia

Mount Isa, west of Cloncurry; great hopes are entertained of this enterprise. Iron ore is believed to be plentiful, but is hardly worked. Tin is of some importance; it is worked mainly at Herberton, in the richly mineralized Atherton Plateau, and in the same district at Chillagoe and behind Cooktown; some also comes from Stanthorpe, in the extreme south. The production in 1929 was valued at £114,000.

The annual coal-production in recent years has averaged about 1,000,000 tons, the bituminous Ipswich field, with some forty collieries, being the most important area. Coal

is also worked at various places in the Maryborough, Dawson valley, Bowen, Clermont, and Darling Downs districts, as well as at Mount Mulligan, on the Atherton Plateau.

Towns and Communications. Apart from Brisbane, with its population of 318,000, the largest cities are Townsville and Rockhampton, with about 30,000 each, and Ipswich and Toowoomba, each with about 26,000. Most of the interior centres which figure on the map vary from a few hundreds to a few thousands. The railway system, of 3 feet 6 inches gauge, is based upon a railway commanding the coast towns from the southern boundary to Cairns, and three main lines, with branches, running westward from Brisbane, Rockhampton, and Townsville, while there are several other shorter lines.

Brisbane, astride the Brisbane river fourteen miles from its mouth in Moreton Bay and away from flats liable to flood, has as its hinterland the broad, low valleys of this river and other streams, the Ipswich coalfield, the Darling Downs, and, by its railways, a large area of the interior. With a dredged channel yielding about 25 feet at low water and its shipping facilities it dominates the trade of Queensland. Its industries are largely concerned with foodstuffs and clothing, but engineering, sawmilling, tanning, and meat-works provide other occupations. The southern railway-line passes through Ipswich (on the Bremer tributary), which sends coal down to Brisbane by water. This city (population, 26,000) is an old settlement, now possessing woollen mills, important railway-works, and iron-foundries. Beyond, Warwick (population, 7000), an old centre on the eastern edge of the Darling Downs, is reached. The town is important for dairying, wheat, and maize. From it a branch of the railway goes southward to Stanthorpe (population, 6000), where tin is worked. The main line continues to Toowoomba (population, 25,500), the commercial capital of the Darling Downs, in an area yielding coal, butter, cheese, cereals, and grapes, and becoming important for cross-bred sheep. It then runs through Dalby to Roma (population, 4000), in the pastoral, wheat, and vine area of Maranoa, and extends beyond Charleville (population, 3000), a centre of large sheep-stations near the Warrego, a river of extreme *régime*. This town's

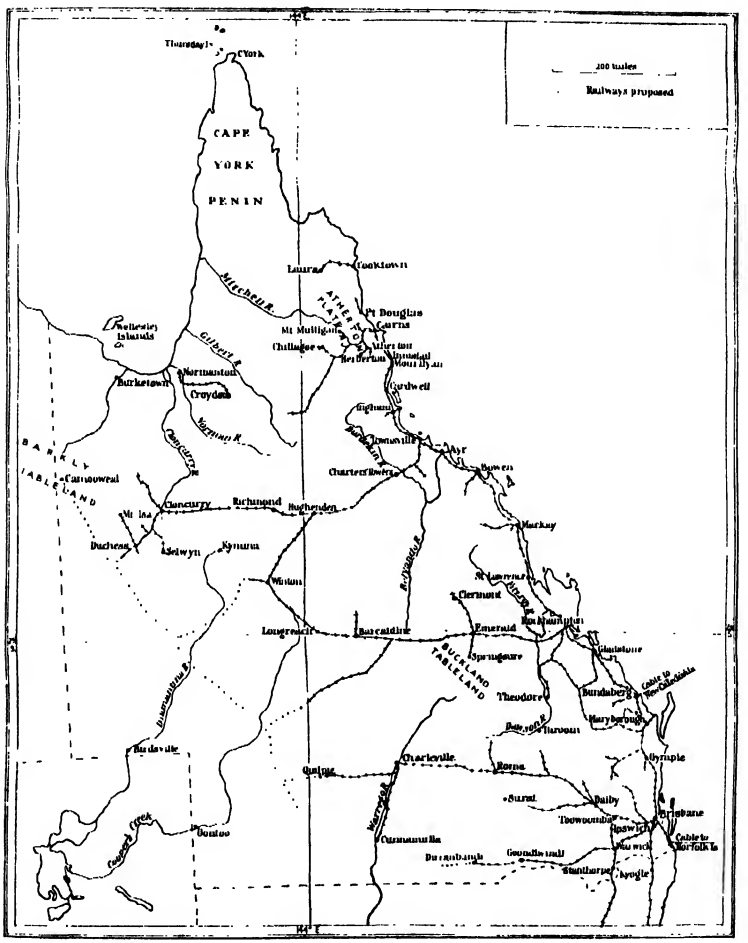

FIG. 83. QUEENSLAND -RAILWAY DEVELOPMENT

supply of water comes from a bore yielding 400,000 gallons a day, as compared with its original flow of 3,000,000 gallons.

Rockhampton (population, 30,000), situated on the Fitzroy, thirty-five miles from the sea, has an immediate hinter-

land of broad valleys (including the Dawson river), in which fruits, maize, sugar, cotton, and dairy products all have importance, and including Mount Morgan and the Dawson river coalfield. From here the central railway climbs to the Peak Downs, centring on Emerald, in a stock-rearing and wheat-growing area, and then goes on to Longreach, the centre of very extensive sheep-runs. A line from Longreach through Winton allows connexion with the northern railway at Hughenden, in an important sheep and cattle area on the Flinders river. This northern line has come from Townsville (population, 30,200), on Cleveland Bay, the second port of the state, interested in sugar, dairying, and meat, as well as in mining products from Charters Towers (population, 9000), though these have mainly given way to agriculture and dairying. Beyond Hughenden the railway goes to Cloncurry, with branches to various mining settlements. Mining will revive here with development at Mount Isa, but this is also sheep and cattle country, with Camooweal as another centre farther west, on the Barkly Tableland.

Cairns (population, 9500) serves the important Atherton Plateau, which is relatively temperate, and likely to develop maize-growing and pastoral industries, besides being occupied with the mining of tin, copper, and silver-lead in the Herberton district, copper at Chillagoe, and coal at Mount Mulligan. The resources include cattle, sugar, bananas, timber, and magnificent scenery attractive to tourists.

Between Brisbane and Cairns the coastal railway passes through Gympie (population, 9600), an old gold centre now producing sugar, bananas, and butter, to Maryborough (population, 12,000), a port serving a district important for all the typical coastal products, besides possessing coal. Beyond, Bundaberg (population, 11,000) is reached, a town with a special interest in refining sugar, then Gladstone (population, 2500), on Port Curtis. Through Rockhampton the line goes on to Mackay (population, 9000), a large sugar centre, and Bowen (population, 3000), a rising port on a fine harbour, and serving a district producing coal, sugar, tropical fruits, and cigar tobacco. Beyond Townsville the chief places of note passed through before reaching Cairns

are Ingham and Innisfail, both of which, like Cairns, are associated with the Atherton Plateau.

Other settlements are Cooktown (population, 600), in a district in which, besides sugar, coconuts, coffee, rice, and ground-nuts have all been produced on a small scale; Thursday Island (population, 1700), the seat of the chief tropical fisheries; and Normanton (population, 300), the principal centre of the gulf cattle industry, situated twenty-four miles up the Norman river and a port for coasting steamers, with a railway to the isolated Croydon goldfield.

It is proposed to extend the westward-running railways and to connect their terminals by a line going on to Camooweal. At present an air-service operates from Charleville, through Longreach, Winton, Cloncurry, Camooweal, to Darwin, with a branch service from Cloncurry to Normanton.

Trade. The oversea trade in 1927–28 showed imports valued at £11,750,000 and exports at £21,850,000. The trade with other parts of the Commonwealth, though very large, is not recorded. The main import items were textiles, hardware, and metal goods and motor-cars. The leading exports were wool (nearly £10,000,000), sugar (nearly £4,000,000), butter and cheese (£3,250,000), and meat (£2,300,000).

New South Wales

Although, relatively speaking, this state ranks second to Victoria in the intensity of its development, in an absolute sense it is the dominating state in the Commonwealth. Covering 10·4 per cent. of the area, New South Wales leads the other states in its population, with about 39 per cent. of the total, and is the chief producer of wool, wheat, dairy produce, and coal, besides being first in manufacturing industry. The boundary with Queensland has been indicated; on the west the state is marked by the meridian of longitude 141° E., and on the south by the Murray to the head of the upper tributary known as the Indi, thence by a straight boundary to Cape Howe. The latitudes may be broadly described as warm temperate; Sydney, rather south of the middle of the state, is in latitude 34° S.

New South Wales was the scene of the first Australian settlement, and mention has already been made of some of the outstanding events of its early history. Its early vague boundaries were considerably modified with discovery and settlement in other parts of Australia; its present area broadly dates from 1863, the only later modification being the cession of 912 square miles of Federal Capital Territory (1911) and 28 square miles at Jervis Bay to the Commonwealth (1915). The development following the gold-discoveries was somewhat chaotic, but the population rapidly increased, reaching half a million by 1871. The railway from Sydney across the highlands reached Orange in 1877. Problems connected with settlement on the land received increasing attention, but it was not until 1898 that a surplus of wheat became available for export. By this time refrigeration permitted an export trade in butter and meat. There have been considerable fluctuations in prosperity, largely arising from the price realized for wool, which remains the leading export product.

Physical Features. The indented character of the coast is due to the drowning of river-valleys by subsidence. The central portion of the coast has as a result several fine natural harbours, notably Port Stephens, Broken Bay, Port Jackson, and Jervis Bay, while sandspits have turned some openings such as Lake Macquarie into lagoons. There are four main physical divisions: the coastal lowlands, the Eastern Highlands, the western slopes, and the interior plains.

The coast region is an undulating plain, generally narrow, but of varying width. By the Richmond and Clarence rivers in the north it is thirty to forty miles wide; elsewhere it is ten to fifteen miles wide, except where a long tongue projects up the Hunter river and in the hinterlands of Broken Bay (the Hawkesbury river) and of Sydney. The western margin of the coastal belt is marked by steep and often inaccessible escarpments cut by deep valleys; even to-day the highlands are crossed by only three railway-lines, one from Newcastle and two from Sydney.

The Eastern Highlands are in this state divided into three

blocks. The Cassilis Gap, marked by the Goulburn tributary of the Hunter—a gap curiously enough not yet utilized by a railway—has to the north of it the New England Plateau,

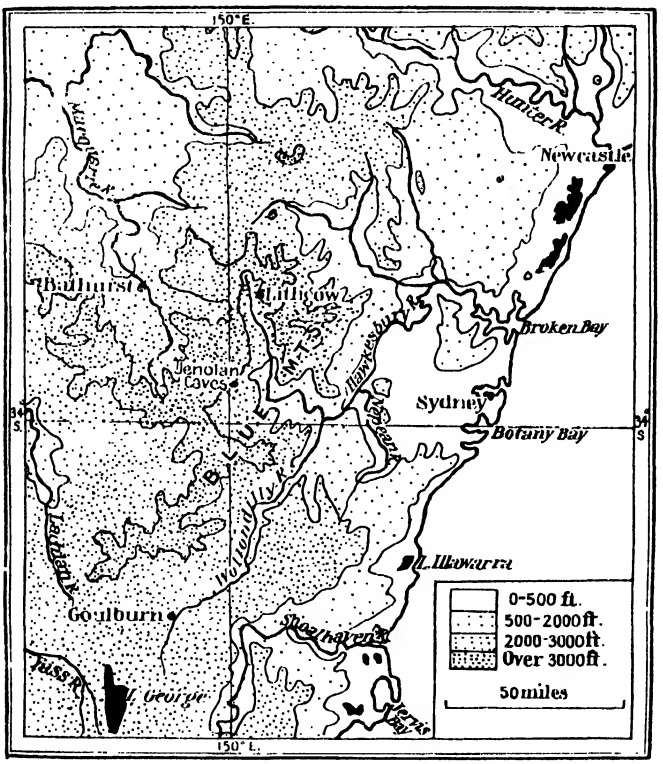

FIG. 84. SYDNEY AND THE BLUE PLATEAU
The lowlands round Sydney are hemmed in by a steep escarpment.

consisting of blocks warped up to different levels, and rising in Ben Lomond to about 5000 feet. The Macleay river has cut a deep gorge. The plateau sends out a spur, largely volcanic, to the west, known as the Nandewar Range, and is bordered on the south by the basalt-capped Liverpool Range, a westerly volcanic projection of which is known as

the Warrumbungles. South of the Cassilis Gap is the Blue Plateau, a belt of limestone, with deep and beautiful valleys such as the Burragorang valley (Wollondilly river—tributary of the Hawkesbury) and many remarkable limestone caves, of which those at Jenolan are famous. A faulted area marked by Goulburn and Lake George (a lake which varies much in size, ponded up against a fault scarp, and without a visible outlet) divides the Blue Plateau from the Kosciusko massif, an upraised block rising in the Snowy Mountains to 7328 feet and with cirques and other evidences of recent glaciation at its highest levels. Lying to the east of this is the Monaro Plateau, at a considerably lower elevation (about 2500 feet). Different parts of the highlands are known locally as 'plains'—for example, the Dorrigo Plains (behind Coff's Harbour) and the Bathurst, Goulburn, Yass, and Monaro Plains.

The western slope, comparatively gentle, is marked, among other features, by the Liverpool Plains north of the Liverpool Range and by the ancient Cobar-Wyalong peneplain, which, though of no great elevation (its maximum is about 1000 feet), constitutes a low upland penetrating on both sides of the Lachlan into the middle of the state. The remainder is lowland below 600 feet, except for the horsts (the Broken Hill Upland and the Grey Range) that appear in the north-west. The lowlands are very level, are mainly of alluvial origin, and are marked by streams of very variable *régime*, which give rise to numerous billabongs. The plains round the Murrumbidgee are known as the Riverina.

Apart from the short coastal rivers, the more important of which have been mentioned above, the drainage is almost wholly to the Murray, and has been described in an earlier chapter (see pp. 70–71). The coastal rivers allow a limited amount of navigation in their lower courses, despite the sand-bar obstructions that usually characterize them. The development of irrigation in the Murray-Darling basin has been detailed on pp. 124–126 and the use of the rivers for navigation dealt with on pp. 127–129.

Climate and Vegetation. The following table for six stations, two in the coastal belt, two on the western slopes, and two

in the interior, brings out the chief climatic differences within the state:

Station	Altitude (Feet)	Highest Mean Monthly Temperature (° F.)	Lowest Mean Monthly Temperature (° F.)	Annual Range (° F.)	Mean Annual Rainfall (Inches)
Grafton .	40	77	57	20	34·5
Sydney .	146	71·5	52·5	19	47·5
Bathurst .	2200	70·5	43	27·5	23·5
Goulburn .	2129	68·5	43	25·5	23·0
Bourke .	350	85	52·5	32·5	11·5
Wentworth .	144	74	47	27	12·5

It is of interest that Kiandra, a station in the Kosciusko district at 4640 feet, has a mean annual temperature of 44·5° F. and an annual rainfall of 65 inches.

The above figures illustrate the decline in temperature southward, the moderate annual range of the coastal belt (note, however, that Grafton, in the north of the state, is somewhat cut off from the sea), and the increase in the annual range with altitude and distance from the sea. The figures for Bourke indicate the great heat of the north-western interior in summer. Almost the whole of the state is subject to night frosts for five or more months, and altitude necessarily makes a difference to the length and intensity of the frosts.

Many coastal stations and exposed places in the Eastern Highlands show heavy rainfall totals, reaching as much as 80 inches in the north-east corner. Broadly speaking, with certain irregularities of distribution due to local causes, the rainfall declines from east to west, and especially toward the north-west. 58 per cent. of the state receives less than 20 inches of rain annually and 14·5 per cent. less than 10 inches. The distribution is important, for average figures show no dry season, and although toward the north-east there is a distinct summer maximum, over most of the state the rainfall is well distributed, with a tendency to a winter maximum in the south of the state. There is, of course, heavy evaporation and uncertainty of rainfall (especially in

the interior), and snow, an important element in the precipitation on the highlands of the south-east, although rare in most districts, has been known over some two-thirds of the state.

The vegetation varies from semi-desert to sub-tropical forest and alpine flora owing to the varied rainfall and elevation. Softwood brush, continuing the tropical forests of Queensland, penetrates along the wet flank of the New England Plateau, while the rest of the coastal belt is well timbered with eucalypt forest. More open country, with much grass, is characteristic of the plateau and the western slopes, while the interior plains are usually classified as grassland,[1] though there is much eucalypt growth, giving way to mulga in the west. In the south-west corner there is an area of mallee country, continuous with that of Victoria and South Australia. The mountain gum appears up to about 5000 feet in the south-east, with alpine plants between this elevation and the snow-line.

Development. With an average of 8 persons to the square mile, New South Wales is rivalling Tasmania for second place as regards density of population. The population, however, notably concentrates on Sydney and its immediate hinterland, and to a lesser degree upon the Newcastle area. The northern coastal districts carry more people than the southern, and the western slopes more than the tablelands, some areas of which are almost uninhabited. In the plains the population is sparse, the Broken Hill district being an island of concentration. There are only about 1500 aborigines.

In the forest areas there are some 500 sawmills, the output of which was valued at £5,000,000 in 1926-27. Huon pine is worked in the brush forests, which cover about one-fifth of the forest area, and hardwoods elsewhere. State plantations (as yet of small total area) testify to the increasing attention given to afforestation, which it is hoped may eventually lead to independence of the present large import of softwood timber.

[1] Often termed 'steppe,' but it seems wise to avoid this term, as it implies very different climatic conditions.

The Great Artesian Basin penetrates into the north of the state and the Murray artesian basin into the south-west corner; the former is much the more important. In 1928 there were 532 bores, of which 388 were flowing, yielding a daily quantity of nearly 800,000,000 gallons. The main basin comes farthest south at Dubbo; Bourke may also be noted on the edge of it.

In the rearing of sheep New South Wales, with half the continent's total, is in a dominating position. At the end of 1928 there were more than 50,000,000 animals, of which fewer than 2,000,000 were cross-breds, mostly kept in mixed farming districts. Some of the finest wool comes from the New England Plateau, where the bracing climate is very favourable. Found all over the state (though there are very few in the coastal districts), sheep exist in greatest density on the south-western slopes, and are of importance in the northern tablelands and slopes and in the Riverina. Extensive squatting still prevails on the western plains, where the carrying capacity is low.[1] Part of the wool clip is retained in the state for manufacture.

New South Wales is far behind Queensland as regards cattle, possessing 2,800,000 at the end of 1928; of these, dairy cows numbered nearly 900,000—a greater number than in any other state. Most of the cattle are in the coastal districts north of Newcastle; the lowest density is naturally in the interior plains, although large areas of tableland carry very few. The state does little more than meet the local demand for beef, but in dairying remarkable progress has been made. The principal dairying districts were formerly along the south coast, but they are now on the north coast, and are spreading also on the south-western slopes and in irrigation areas. In a recent year, of a total estimated production of 280,000,000 gallons of milk, 236,000,000 gallons came from the coastal districts, mainly north of Sydney. Most of the milk is made into butter, the oversea export of which was valued at about £1,250,000 in 1927-28.

[1] In some areas it sinks below 1 sheep per 10 acres. More than 60 per cent. of the area of the Western Division is leased in 195 holdings, each exceeding 100,000 acres, and totalling over 48,000,000 acres.

In that year meat (chiefly mutton and lamb) contributed £630,000 to the export trade, but the value of hides and skins, together with minor animal products, was £5,500,000, to which rabbit-skins contributed nearly £2,000,000. Pigs

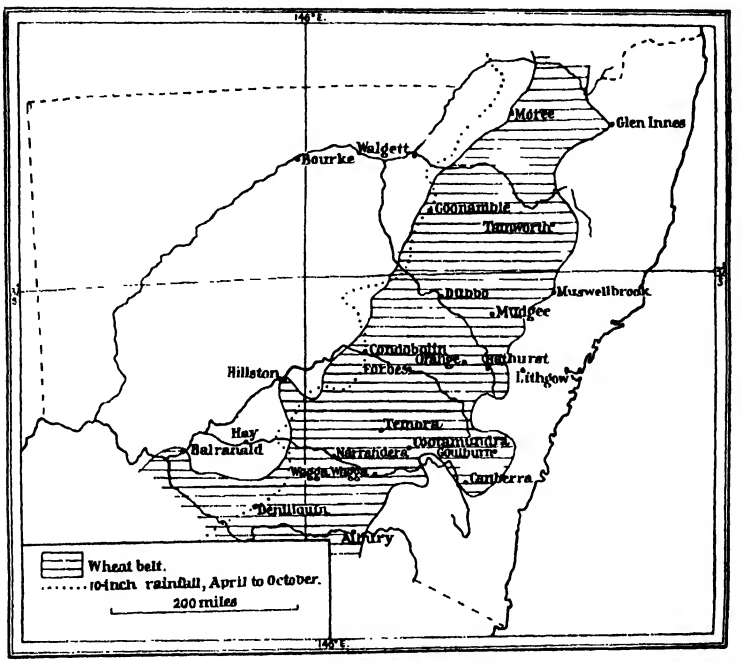

FIG. 85. NEW SOUTH WALES—WHEAT BELT

The shaded area represents the region within which profitable wheat-growing can from experience be carried on. Note the close correspondence of the western margin of the belt with the 10-inch isohyet for the winter six months. Wheat avoids the arid region as well as the wetter coastal belt.

are chiefly kept in the agricultural districts, where poultry-keeping and bee-keeping are also carried on, all contributing to a small extent to the export trade. Horses—nearly one-third of the Australian total—are reared, mainly for local use.

There is a considerable variety of agricultural products. At one time maize was the leading crop, but the remarkable and still steady expansion of wheat not only makes it easily the leading crop, but places New South Wales (though closely

rivalled by Victoria) as the largest wheat-producer among the states. Normally three-quarters of the cultivated acreage is under wheat, and the bulk of the crop is grown between the 11-inch and 15-inch April-to-October isohyets, though it is successfully grown on 9 to 10 inches of winter rain, and on even less by dry-farming methods. Little is grown where the winter rainfall exceeds 20 inches. Neither the tablelands proper nor the northern areas with a tendency to a summer maximum of rainfall are as suitable as the central and south-western slopes. The crop is capable of great extension, and with time the limit of wheat-growing is moving farther west. From 3,000,000 acres in the year 1927–28 the yield was 27,000,000 bushels, an average of 8·9 bushels per acre, which compared with 14·2, 11·6, and 16·8 bushels per acre in the three preceding years. Railways carry the grain to Sydney, the principal port for the crop.

Maize (150,000 acres in 1927–28) is the second grain crop, but often insufficient is grown for local needs. The well-watered coastal valleys, especially north of Sydney, are very favourable for this crop, little of which is grown elsewhere. Generally speaking, the area under maize has declined.

Oats ranks third, and is chiefly found in the Riverina, though the elevated areas of New England and the Monaro are very suitable for it; there is generally an import. Among other cereals grown for grain, rice is the most important; 10,000 acres of rice were harvested in the Murrumbidgee irrigation area in 1927 28 and 14,000 acres in the next year, the yield per acre showing a considerable advance. A little barley (largely for malting purposes) is grown, and considerable quantities of potatoes are raised. There are very large acreages under wheat and oats for hay, while much lucerne is grown in irrigation and coastal districts, as well as green fodder, which ranks second to wheat as regards acreage. Some 8500 acres of sugar-cane—grown in the lower valleys of the Clarence, Richmond, and Tweed—were crushed in 1927–28, meeting, however, only a small proportion of the state's needs of this commodity. The cultivation of cotton is negligible, and is at present confined to a small area in the Grafton district.

Irrigation largely subserves vine- and fruit-growing. The principal area is 250 miles down the Murrumbidgee from the Burrinjuck dam; it contains at present some 2000 farms, covering about one-third of the reserved area, which includes both irrigable and non-irrigable land. The chief settlements are Yanco, Leeton, and Griffith, where experimental farms illustrate the careful attention given by the state Government to farming generally. Vines, deciduous and citrus fruits, figs, olives, vegetable and fodder crops, rice, dairying, and pig-raising represent the varied activities of the area. Elsewhere the small pumping-scheme at Hay—also on the Murrumbidgee—dates from 1893, but little fruit is grown here; in the Wentworth district, on the Murray, are two pumping-schemes somewhat larger than that at Hay, and vine- and fruit-growing are leading occupations. The Hume reservoir will in the first instance be limited to a capacity of 2,000,000 acre-feet; New South Wales and Victoria will each have 40 per cent. of the water-supply and South Australia 20 per cent. Construction of the Wyangala dam, on the Lachlan river, fourteen miles west of Cowra, has commenced, but this is primarily to supply domestic water to an area of mallee country, in which wheat-growing should develop.

In 1927-28 there were 13,000 acres of bearing vines, more than half of which were for wine, the rest of the acreage being roughly equally divided between grapes for table use and for drying. Although grapes are still grown in the hinterland of Newcastle, the principal area for them is now the Murrumbidgee irrigation district. Nearly 3,000,000 gallons of wine were made; although currants and raisins are produced, the grapes grown for drying are mainly sultanas. It is not thought that vine-growing will expand to any great extent.

The state has generally a surplus (exported to New Zealand) of oranges and mandarins, grown not only in the hinterland of Sydney and in coastal districts to the north, but also in irrigation areas. The area under deciduous fruits (of which there is not normally a surplus) is capable of considerable extension; the central tableland, the south-west slopes, and the irrigation areas participate in this production.

Bananas have some importance in the north-east coastal lowland, but the pineapple production is negligible.

In mining New South Wales dominates in coal-production. The Coorabin area in the Riverina is unimportant, as also is Gunnedeh, west of Tamworth, where coal is also found. In the main coal basin production is confined to three districts: (1) the northern district, where the so-called Greta

FIG. 86. BROKEN HILL.

By courtesy of the Immigration Office, Commonwealth of Australia

measures (productive lower seams) crop out, and where West Maitland, Cessnock, and Muswellbrook, the chief centres, produce the bulk of the state's output; (2) the western district, with Lithgow; (3) the southern or Illawarra district, in the hinterland of Wollongong and Port Kembla. In 1928 the total production was 9,500,000 tons, some reduction on the average output, and more recently a prolonged stoppage has affected the industry. The Broken Hill district produced in 1929 silver-lead ore and concentrates to the value of £3,000,000 and zinc concentrates valued at well over £1,000,000. Tin-production, largely obtained by dredging in the Emmaville and Tingha districts, was valued at £190,000,

but gold declined in value to £32,000, while copper, formerly important with gold in the Cobar district, showed an unimportant yield. Iron ore, though widely distributed, is only produced in any quantity in the neighbourhood of Lithgow. Limestone is worked both for flux and (more extensively) for cement-making, while there is some production of opals, largely from White Cliffs.

The average estimated numbers of persons employed during 1928 in the principal industries were:

Manufacturing	182,700
Rural	134,200
Mining	26,700
Forestry, fishing, and trapping	8,000

It is clear that manufacturing is a very important part of the economic activity of the state. The iron and steel works of the Newcastle and Lithgow districts, to which it is likely will shortly be added considerable developments at Port Kembla, give New South Wales outstanding importance in this category of production, but although considerable progress has been made in the textile and clothing industries, the state in this respect is still behind Victoria. These represent the leading industries of New South Wales. While in certain industries the factories are scattered, as with sawmills and butter factories, in others there is considerable concentration in the metropolitan area, as in the case of clothing, boots and shoes, flour, bricks and tiles, and machinery, while in general, apart from the Lithgow area, industry is not important beyond the coastal belt. It is of interest that electricity is generated at the Burrinjuck dam and distributed to Wagga and Young.

Towns and Communications. The railway development, with a length of 6000 miles, of standard gauge, is primarily based upon Sydney, with Newcastle as a subsidiary coastal terminal. While a line traverses the coastal districts to the Queensland frontier in the north, southward it only reaches Nowra, physical and economic considerations preventing further extension. Both the northern and southern plateaus are served, the northern by a line from Newcastle, which climbs at Ben Lomond to 4473 feet, and the southern by a

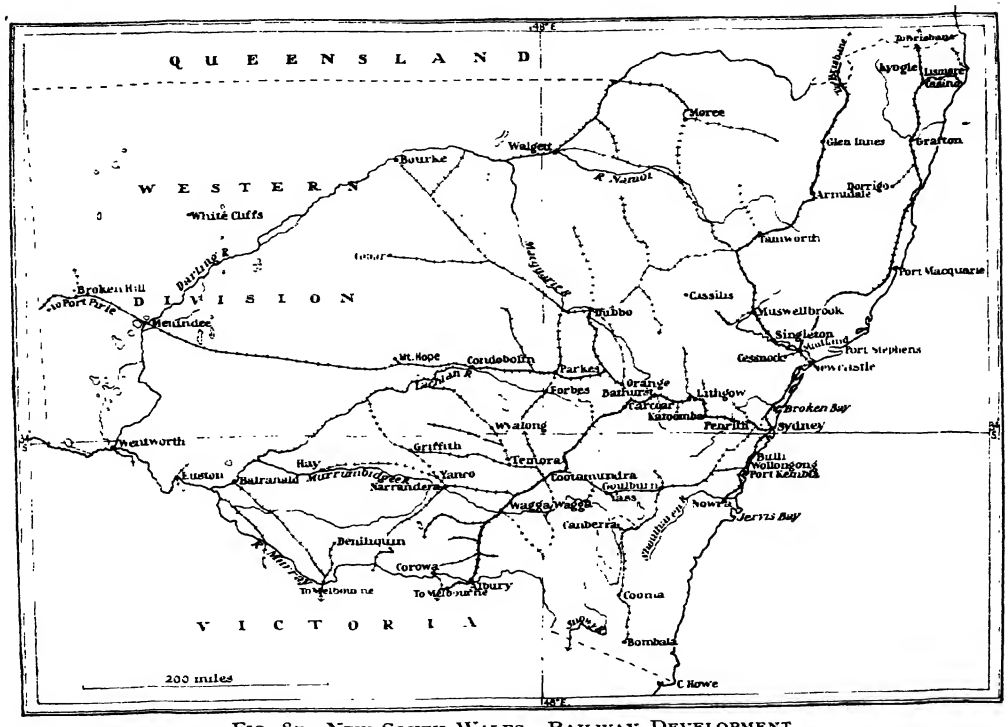

FIG. 87. NEW SOUTH WALES—RAILWAY DEVELOPMENT

Note the two routes from Sydney to Brisbane. The boundary of the Western Division is shown by a dotted line.

railway *via* Goulburn and Queanbeyan. Two lines from Sydney and one from Newcastle cross the highlands, beyond which a relatively close network of railways serves the western slopes and adjacent plains, with long arms stretching out to Hay, Broken Hill, Bourke, and Walgett.

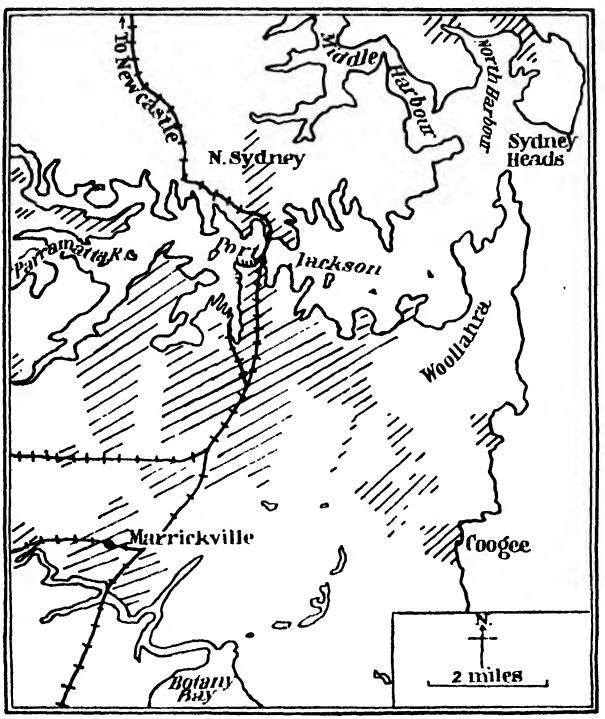

FIG. 88. THE POSITION OF SYDNEY

Note the docks, where the railways from the south reach Port Jackson, and the new bridge.

Apart from Sydney and Newcastle, with their suburbs, New South Wales contained, at the end of 1928, only six municipalities with population exceeding 10,000. Broken Hill (population, 23,260) ranks third if the suburban municipalities of the two dominating seaports be excluded, with Lithgow and Cessnock following. Goulburn (population, 12,690) is the largest interior centre without mining interests.

Sydney (population with suburbs, including Parramatta, 1,238,660, within an area of 685 square miles) owes its importance to historical and social developments as much as to physical reasons. Port Jackson, a typical drowned area of 22 square miles, into which runs the short Parramatta river, is one of the world's finest harbours; it is entered between Sydney Heads, sandstone cliffs with a passage between them about three-quarters of a mile wide and 80 feet deep at low water. There is a considerable amount of lowland in the immediate hinterland, by the Parramatta, Nepean, and Hawkesbury rivers, in which dairying and deciduous fruits have importance, round centres such as Parramatta, Penrith, and Richmond. Sydney, however, owes most to the concentration of government, roads, railways, and commerce that marked its development when once the difficulty of crossing the Blue Mountains was overcome. Sydney is also the chief port for the island trade of the Pacific Ocean. Besides its banking, warehousing, and shipping interests, the metropolitan area concentrates a considerable amount of manufacturing; there are more than five thousand factories, some being large undertakings, associated among other things with flour-milling, wool, clothing, leather, machinery, sugar, meat, and tobacco. State railway-workshops are included in the area, and the famous Sydney wool sales attract buyers from many lands. Sydney Harbour Bridge, nearly completed, will provide road and rail connexion between the main city and North Sydney; a remarkable engineering feat, its main span exceeds 1670 feet, 170 feet above the water-level. Port Jackson is justly famed for its beauty.

The main western line from Sydney crosses the Hawkesbury (formed by the junction of the Wollondilly and Nepean) at Penrith, and climbs the escarpment to Katoomba (population, 10,250), a flourishing pastoral and fruit-growing centre, near which are the remarkable Jenolan Caves; it turns north to Lithgow (population, 15,170), which at 3000 feet mines steam and coking coal, smelts iron ore from Carcoar and Cadia, some distance to the south-west, possesses iron and steel works, the Commonwealth small-arms factory, brick-works, tweed mills, and sawmills. The line reaches the wheat

belt at Bathurst (population, 9160), on the Upper Macquarie, at a height of 2153 feet, of little importance now for gold, but with flour-mills, railway-workshops, and other factories. Beyond the railway goes to Orange (population, 8470) and Parkes (population, 5660), in the wheat belt, and on to Condobolin (population, 1790), on the Lachlan, in the central plain. A long stretch across the western plains runs through Menindee, a pastoral centre on the Darling, to Broken Hill (population, 23,260), 700 miles west of Sydney, the mining importance of which has been described. This town contains half the population of the Western Division of the state.

From Orange a branch runs out through Dubbo (population, 5680) in the wheat belt to Bourke (population, 1640), an outstanding sheep centre on the Darling, with a link to Cobar (population, 1050), where pastoral interests have taken the place of mining. Other branches may be followed to farming centres, some of which, like Forbes, Temora, and Wyalong, were once important for minerals.

The southern line goes across the southern tableland *via* Goulburn (population, 12,690), an important agricultural, pastoral, and tourist centre, with woollen mills, where the Lake George gap provides a relatively easy route across the highlands. Beyond Yass (population, 2650) this line passes through the wheat belt at Cootamundra (population, 4080) and Wagga Wagga (population, 8930); the latter, on the Murrumbidgee, links up with Albury (population, 9250), at the extreme limit of navigation on the Murray, where connexion with the Victorian railway-system is established. Albury, an important agricultural and sheep centre, is likely to develop considerably with the completion of the Hume reservoir. It is situated at an old fording-point of the Murray, and possesses woollen mills. From Cootamundra a branch runs through Narrandera (population, 3660), in the Riverina, serving the Murrumbidgee irrigation area, and goes on to Hay (population, 2360). Goulburn is a junction for the line which runs through Queanbeyan (population, 4000) *via* the Cooma Gap to the Monaro Plateau and is linked with Canberra (pp. 120–121).

The northern line from Sydney runs first to Newcastle.

This city (population, with suburbs, 103,000) is situated at the mouth of the Hunter river, and possesses a large and fertile hinterland, rich in coal.[1] Besides its iron-smelting and varied iron and steel manufactures, it has other industries, ships large quantities of coal, and has a big general trade; it is the fourth port of the continent. Constant dredging is needed, however, to keep the port clear, and from this

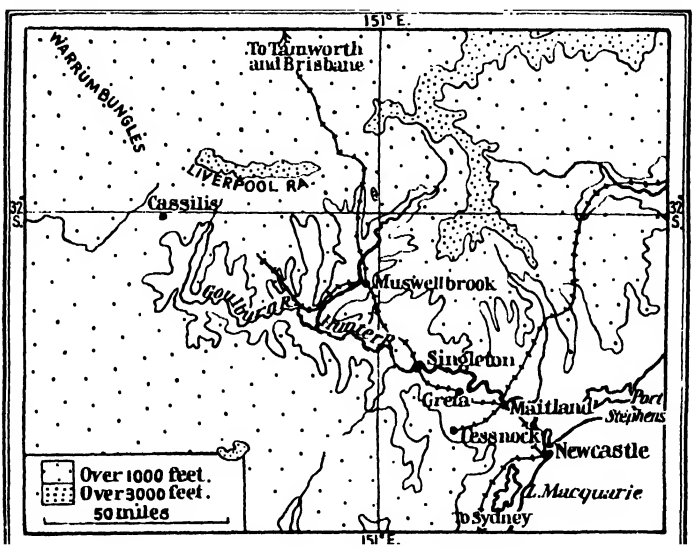

FIG. 89. THE HUNTER VALLEY

point of view Port Stephens might prove a better outlet. The railway goes up the Hunter to Maitland (East and West; total population, 11,800), where horse-breeding, maize-growing, and dairying are all important (seven or eight crops of lucerne a year are obtained from the river-flats), while the Greta coal-measures are near by, now largely mined at Cessnock (population, 14,000). Continuing up the Hunter valley, the line passes through Singleton (population, 3400), with similar occupations, and once famous for wine-growing,

[1] This important area has been described in *A Study in Social Economics: the Hunter River Valley*, by F. R. E. Mauldon (Melbourne, 1927).

and Muswellbrook (population, 2500), and turns northward through Tamworth (population, 7560), the chief centre of the Liverpool Downs, to reach Armidale (population, 7200) and Glen Innes (population, 4600), centres on the New England Plateau for grazing, dairying, and maize. This line provides a link with Brisbane.

From Newcastle a line follows the maize-growing and

FIG. 90. STEEL WORKS, NEWCASTLE, NEW SOUTH WALES
By courtesy of the Immigration Office, Commonwealth of Australia

dairying coastal district through Port Macquarie (population, 1700) to Grafton (population, 4800), Casino (population, 3400), and Lismore (population, 9500). These are situated in the lowland round the Clarence, Tweed, and Richmond rivers, an area providing all the sugar and half the butter of the state. A standard-gauge railway connexion has recently been established through the Macpherson Range between Kyogle and South Brisbane—part of the scheme to link the mainland capitals without break of gauge.

The south coast line, running for 100 miles from Sydney to Nowra (population, 2150), is likely to become of increasing

importance. The Illawarra district is marked by a very narrow coastal plain, bordered by a precipitous scarp in which torrential streams have exposed the coal-measures in such a way as to facilitate horizontal adit working and gravity transport. Coal is mined principally at Wollongong (population, 10,200), and excellent steam and coking coal is available. Port Kembla is of rising industrial importance; it already possesses copper-smelters and meat factories, besides making fertilizers, while enormous iron-smelting works are about to be established. This district is important for dairying, and possesses magnificent scenery, which attracts many tourists.

It is worthy of note that a number of centres in the Riverina and along the Murray, such as Deniliquin (population, 3000), Balranald (population, 1000), at the extreme western limit of wheat-growing, and Wentworth (population, 1000), are connected with the Victorian railway-system (see p. 130 and Fig. 95).

Air-services (once or twice a week) operate on the following routes: (1) Adelaide *via* Mildura, Hay, and Narrandera to Cootamundra; (2) Hay *via* Deniliquin and Echuca to Melbourne; (3) Mildura to Broken Hill.

Trade. For 1927-28 the imports were valued at £65,000,000 and the exports at £52,000,000. Among the imports a large variety of manufactured goods figured prominently, including much machinery and electrical goods, and apparel and textiles (largely cotton and silk), while tobacco, oil, motor vehicles, and timber were all important. The wool export, mostly 'greasy,' reached £30,000,000, and wheat and flour (there was a relatively small surplus in this year) totalled £2,750,000. Rabbit-skins, sheepskins with wool, lard, and butter were each valued at between one and two million pounds.

Lord Howe Island

A dependency of New South Wales, this volcanic and elevated island—it reaches 2840 feet in Mount Gower—is situated about 450 miles north-east of Sydney, covers five square miles, and has a population of about 110 people. It

has a luxuriant vegetation, but only half a square mile is cultivable. The native or Kentia palm (belonging to the areca family) is grown for its seed, and communication is maintained with Sydney.

Victoria

This is the most temperate of the mainland states, and lies approximately between 34° S. and 39° S. In proportion to its area and population it is the most intensively developed, for it covers only 2·96 per cent. of the total Commonwealth area, but has a population of over 1,750,000, or nearly 30 per cent. of the Australian total, giving a density of 20 to the square mile. It is of interest that its area approximates to that of the island of Great Britain. The boundary with New South Wales has been indicated; on the west a stretch of 240 miles marches with South Australia along longitude 141° E.

It has been pointed out that the colony of Victoria made a relatively late start. An attempted settlement at Port Phillip in 1803 was abandoned in the following year, and a similar fate met a settlement founded at Western Port in 1826. The first successful settlement was at Portland Bay in 1834; Melbourne was established in the following year, and with the coming of 'overlanders' from New South Wales development was relatively rapid. The separation from New South Wales in 1851 coincided with the beginning of the gold-rush, which increased the population sixfold between 1850 and 1857, besides promoting railway development. More recently pastoral, agricultural, and manufacturing occupations have dominated the state's activities, and noteworthy examples of state Government activities are to be found in the control of the water-supply and in the development of the Yallourn brown coal deposits.

Physical Features. Victoria is naturally divided into four main physical regions, with a west-to-east parallelism. These are in order from north to south (1) the north-western plains, (2) the central highlands, (3) the Great Valley, (4) the southern highlands. Victoria may also be divided, by a line

drawn roughly north and south between Echuca and Melbourne, into widely different eastern and western regions. To the east the central highlands are broader and higher, with a well-defined watershed contrasting with the often poorly defined drainage to the west. Moreover, the bulk of the gold-bearing rocks associated with the central highlands lie in the west; the western half of the Great Valley is covered

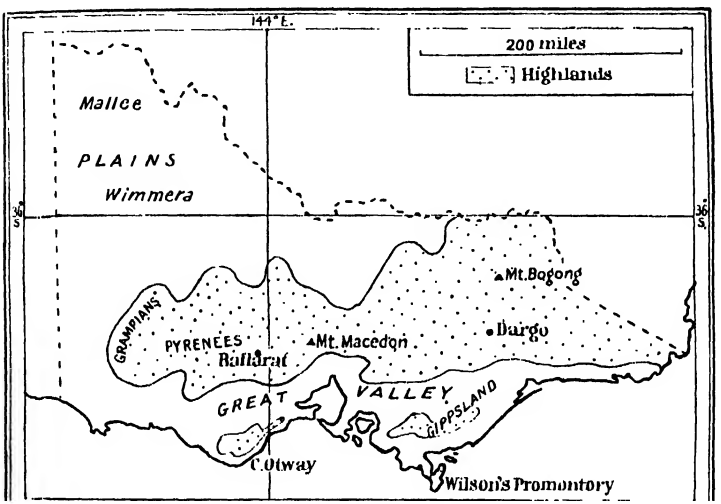

FIG. 91. VICTORIA—PHYSICAL DIVISIONS

with recent volcanic rocks hardly found to the east, while most of the plain land lies in the Murray basin west of Echuca.

The central highlands consist of block mountains or elevated peneplains. In the west are the Grampians, block mountains marked by step-faulting, which trend north to south. Farther east are the Pyrenees and the Ballarat plateau, where Mount Macedon, capped with volcanic rock, reaches 3324 feet. Then comes the Kilmore Gap, north of Melbourne, where the watershed between north and south sinks to 1115 feet. To the east rise the Australian Alps, a deeply dissected highland in which erosion is very active. Mount

Bogong, the highest point of a granite massif, is 6508 feet, and overlooks the Mitta valley from the west. In the same neighbourhood a number of other points exceed 5000 feet, and the Omea Gap, between the Tambo and Mitta rivers, has a height of 2400 feet. Plateau areas in this region are relatively small; they include the Dargo High Plains, which lie toward the east of the state, north of the divide.

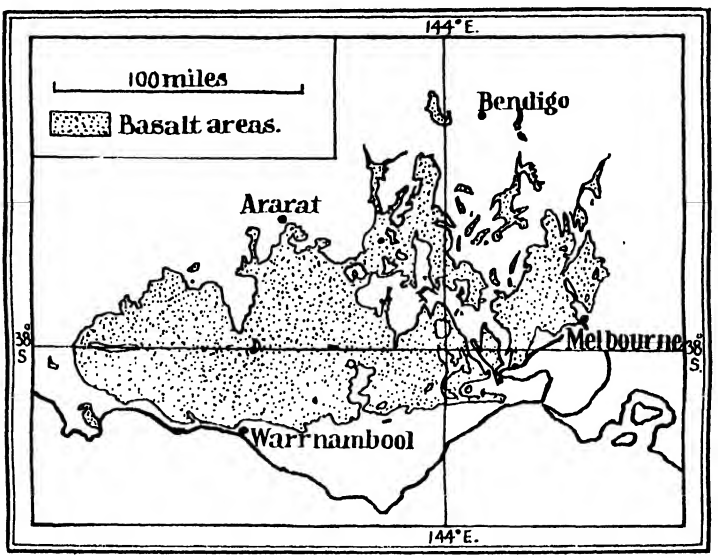

FIG. 92. THE BASALT PLAINS OF VICTORIA
Note how the lava flowed down valleys.

The southern highlands of Otway and Gippsland are fragments of a mainly subsided highland. They reach nearly 2000 feet, but Wilson's Promontory, connected to the mainland by an isthmus of low sand-dunes, is an outlier of granite which rises some 500 feet higher.

The Great Valley is divided by Port Phillip (an area subsided between parallel faults) into the Corangamite valley in the west and the Gippsland valley in the east. The former is overlaid by 10,000 square miles of basaltic lava, ash, and other volcanic material, which on disintegration gives very

fertile soil; extinct cones are numerous. In the far west the Great Valley merges into the plain of the Glenelg, which links the valley with the north-western plains. East of Port Phillip is Western Port, another sunken area, bordered on the north by the Koo Wee Rup swamp, now drained; this leads to the Gippsland valley, filled with recent deposits and of low elevation, with drainage blocked at the eastern end by the sand-dunes of Ninety-mile Beach. (See Fig. 96.) The eastern half of this valley is the slightly elevated bed of an old estuary, in which were formed the brown coal deposits of Yallourn and Morwell.

The north-western plains include not only the Wimmera and Mallee districts, but also a considerable area farther east, round the Lower Goulburn. These plains are included in the Murray artesian basin, representing a Tertiary extension of the sea. Alluvial deposits occupy the eastern part; the Tertiary rocks of the western half have a capping of alluvium, and are varied by low sandhills and granite masses. In the Mallee are large areas of limestone and quartzite due to the indurating of the soft deposits through the evaporation of underground water containing lime or silica which has percolated upward.

The Indi and the Mitta rivers are important upper tributaries of the Murray. The Snowy, another river of the torrential type, has formed considerable flats at its mouth. The shallow Gippsland lakes—*e.g.*, Lake Wellington—occupying depressions in the old sea-floor, are being rapidly silted by the Latrobe, Mitchell, and other rivers. The Yarra, flowing to Port Phillip, has by cutting back captured much water flowing southward from the central highlands, and the Upper Goulburn has done the same on the northern flank. This river is the chief of those flowing to the Murray, for the Loddon, farther west, struggles with difficulty to the main river, and in the Wimmera others are lost by absorption and evaporation or end in salt lakes. Other salt lakes are found in this area in hollows due to wind erosion or blocked by sand-dunes. Many small lakes occur in the western half of the Great Valley, occupying craters or subsidence hollows in the lava, or due, like Lake Corangamite, to the blocking

of a valley by a lava-flow. Apart from the Murray, limited navigation is possible on the Goulburn, Yarra, and Latrobe rivers.

It is noteworthy in connexion with the considerable earth-movements of both elevation and subsidence that have contributed to the structural features of Victoria that earth tremors are common.

Climate and Vegetation. The mean monthly temperature at Melbourne ranges from 48·5° F. to 67·5° F., and variations within the state are not, apart from elevation, considerable. Melbourne has to some extent an interior position, and the southern coast enjoys a somewhat more moderate climate; on the other hand, the daily and annual ranges in the Murray lowlands are considerably greater, and the stations along the river average about 72° F. in January, when heat is combined with limited rainfall.

The rainfall largely reflects the distribution of highland. About 45 per cent. of the state, all in the north-west, has less than 15 inches of rain annually, and the 20-inch isohyet closely follows the northern edge of the central highlands, although in one or two small areas near Geelong the rainfall declines somewhat below this figure. The heaviest rainfalls occur in the Otway and Gippsland highlands and on the higher parts of the Australian Alps, some stations in all these districts showing more than 60 inches. Melbourne's figure of 25·5 inches illustrates the rainfall of the Great Valley, some parts of which, however, immediately east of Port Phillip, have more than 30 inches. Hopetown, with barely 12 inches, illustrates the rainfall of the Wimmera. The distribution of rainfall is specially important, and, while average figures show no dry season, most stations show a distinct winter maximum; broadly speaking, the rainfall is of the winter-rain type, and is brought by Antarctic 'lows.' This has special importance for wheat-growing. Apart from that in the north-west, the Victorian rainfall is generally more reliable than that of most of the continent.

The south-east of the state, as well as the Otway highlands, was originally well forested, but large clearings have been made by forest fires and in connexion with mining and

farming. The timber is almost exclusively eucalypt in character; important varieties include stringy bark, ironbark, silvertop, blue gum, and mountain ash. The forests of the slopes of the Australian Alps are largely inaccessible, and give out at about 5000 feet. Belts of red gum follow the Murray and its tributaries and the Glenelg, while there is a large area of mallee country in the north-west, where belts of cypress also occur. Much of the country by the Murray may be described as parkland in character, but most of the western half of the Great Valley is covered with grassland.

Development. The population notably concentrates round Port Phillip and Western Port, nearly 60 per cent. of the total being found within the metropolitan area itself. An area of considerable density extends to Ballarat and Bendigo. From this well-peopled central area the density declines eastward, where the more elevated country occurs, and westward and north-westward as the aridity increases.

Forestry has become a concern of the state, and nearly a third of the timbered area is set aside as state reserves; the deficiency in softwoods has led to the encouragement of coniferous plantations by the supply of plants from state nurseries to private growers, public bodies, and schools. The clearing of mallee land for wheat-production is leading to sand-drift, and it is thought that tree-planting will be necessary if this movement is to be stopped. In 1927–28 nearly 200 sawmills (notably in Otway and Gippsland) had an output of sawn timber valued at more than £750,000. Eucalyptus oil is produced in large quantities; there is some export, but the bulk of the crude oil is used in Australia for metallurgical purposes.

In proportion to its area Victoria has many cattle—1,304,000 at the end of 1928. Of this number 626,000 were dairy cows, which shows that dairying is relatively far more important in this state than in any other. In actual numbers of dairy cows Victoria and Queensland now rival each other for second place after New South Wales; the development of this industry in Queensland, where the population is much smaller, has been very rapid. Notable dairying centres are Terang and Colac, in the Corangamite valley, where the

volcanic soils are very favourable, Morwell and Bairnsdale, in Gippsland, and Kerang, among irrigation districts (which have 10 per cent. of the dairy cows). This occupation is naturally of little importance in the extreme west and north-west. Butter is a large export. Many cattle are grazed for slaughtering, but the trade in beef is almost entirely local.

With nearly 16,500,000 sheep at the end of 1928, Victoria rivalled Queensland, though far behind New South Wales. The eastern half of the state has relatively few; the western half of the Great Valley carries very large numbers, and the Wimmera, Mallee, and northern districts, though more lightly stocked, have also many. Most of the flocks number under 2000, and the tendency is for the really big runs (in 1925 seven flocks exceeded 20,000), which are mainly in the west, to be broken up. The wool export is big, but there is an increasing local demand (more than 20 per cent. of the clip in 1927–28) for manufacturing purposes. The climatic conditions in many parts, as well as the development of mixed farming, tend to favour the production of mutton and lamb, the export trade of which was valued at £750,000 in 1927–28.

The number of horses, some 400,000, is tending to decline. Although the number of pigs fluctuates round about 250,000, Victoria is a considerable producer of bacon, of which there is some export. Bee-keeping has made progress in several districts. With an annual expenditure by the Government in recent years of nearly £100,000 on rabbit-destruction, it is not surprising that rabbit-skins were exported in 1927–28 to the value of more than £500,000. Fishing employs some 1300 men—chiefly at sea, but also in the Gippsland lakes. Nevertheless, the import of tinned fish is twice the value of that marketed locally.

The latitudes of Victoria limit agriculture to crops of the more temperate type, and though the state has a relatively good and reliable rainfall, large schemes of water-conservation have been undertaken. Most notable are those on the Goulburn river, which, begun with the weir at Nagambie and the utilization of the Waranga depression as a reservoir, have been vastly developed by the building of the Sugarloaf reservoir higher up, where the Delatite joins the Goulburn.

Shepparton and Echuca are important centres in a large irrigated area round the Lower Goulburn. Next in importance are works on the Loddon, which, combined with pumping and the use of water held up behind the Torrumbarry weir, allow irrigation in a large area round the Lower Loddon, where centres like Kerang and Swan Hill are situated. Lower down the Murray is the old-established area of Mildura, with Red Cliffs adjacent to it on the east. Further development will be possible when Victoria's share from the Hume reservoir is available. Minor schemes include that on the Coliban river to supply the Castlemaine and Bendigo districts, that on the Werribee west of Melbourne, the Glenmaggie weir on the Macalister river, in Eastern Gippsland, supplying Maffra and Sale, a small scheme in the Mornington Peninsula, between Port Phillip and Western Port, and storages at the northern foot of the Grampians to supply domestic and stock water to the Wimmera and Mallee areas. Some 370 subartesian bores serve the sheep industry of the north-west.

In 1927–28 nearly half a million acres were under irrigation; of this area 25 per cent. was under lucerne, 25 per cent. devoted to pasture, 15 per cent. to vineyards and orchards, 19 per cent. to cereals, chiefly wheat, and the rest to fodder. The amount of wheat grown under irrigation is not large, but a high yield is obtained, and irrigation water may be used to save a wheat crop from drought. The importance of dairying in such districts has been referred to. The progress of the Mildura area, where development began in 1887, is illustrated by an increase in the population from 2321 in 1801 to 15,200 in 1928.

With 3,000,000 acres under wheat in 1927–28, this crop covered 62 per cent. of the total cultivated area. Production has increased in recent years with the introduction of improved methods of farming—the use of a proper rotation and of fertilizers; the biggest extension has taken place in the Mallee, which now normally produces, using dry-farming methods and the stripper-harvester, some 30 per cent. of the total crop. The Murray lowlands grow most of the wheat, but the yield in the north-west is not generally so high as that elsewhere, and the variations are considerable. The

average yield in 1927–28 was 8·54 bushels per acre, as against 16·8, 11·64, and 17·51 bushels in the three previous years. The Mallee district yielded only 3·35 bushels per acre, as against 12·96 in the previous year.

Oats is the second cereal crop, occupying one-sixth of the area of wheat, and is chiefly grown in the same districts. Barley and potatoes cover a much smaller area, chiefly in the hinterland of Melbourne and in Gippsland, the latter area also growing a little maize in connexion with dairying. The hay acreage is large—oaten hay being chiefly grown—but hops and tobacco cover only an insignificant acreage. There is a rising production of sugar-beet in the Maffra irrigation area.

Vines (about 40,000 acres), grown to a limited extent in many districts, concentrate in the irrigation areas, and especially in the Mildura district, which in 1927 28 produced 70 per cent. of the grape yield; the rest came largely from Swan Hill, Shepparton, and Rutherglen, the last a non-irrigation area along the Murray, near Albury. About one-seventh of the crop is for wine, but raisins, sultanas, and currants, in which the Mildura district specializes, form the bulk of the production. Orchards cover some 80,000 acres, and are widely distributed; they are found not only in irrigation districts, but in other areas, such as the Bendigo district and others east of Melbourne, in which apples have special importance. Many other fruits, particularly peaches, are grown in smaller quantities. Market-gardening is extensively carried on in the neighbourhood of the metropolis, especially in the reclaimed Bacchus Marsh and in the Werribee area.

Metal-mining has now little importance. Gold-production, mainly from reefs in the Beechworth, Bendigo, and Castlemaine districts, was valued at £144,000 in 1928 and employed only 655 men. A little tin is obtained by dredging in the Beechworth area. Coal-production employs over 2000 workers; black coal was produced to the extent of nearly 660,000 tons in 1928, 90 per cent. coming from the state coal-mines at Wonthaggi, Outtrim, in the same area, being another centre. There has been a great development of the

brown coal deposits at Morwell and Yallourn, the latter centre yielding the bulk of the production of 1,600,000 tons for the big state electricity enterprise.

Manufacturing, in which Victoria rivals New South Wales, employs 160,000 persons, in more than 8000 factories; this

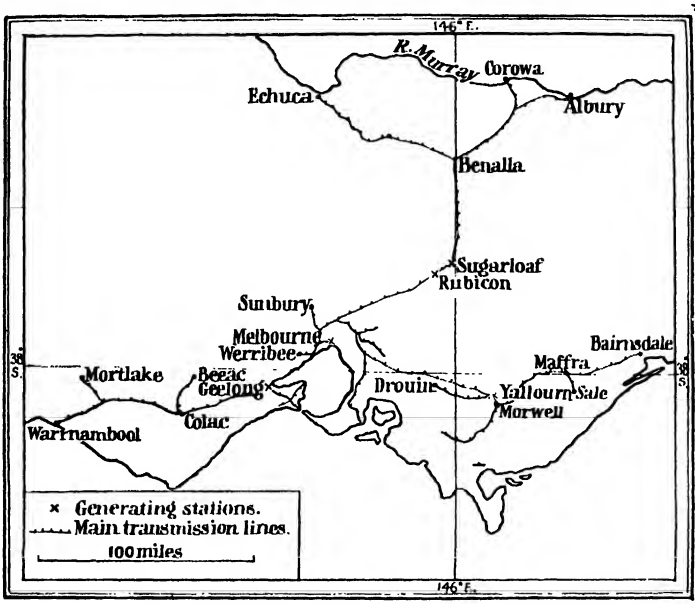

FIG. 93. VICTORIA—MAIN TRANSMISSION LINES OF THE STATE ELECTRICITY COMMISSION

The brown-coal station at Yallourn and the hydro-electric schemes at Sugarloaf and Rubicon provide current over wide districts, even to places on the New South Wales side of the Murray.

number is substantially greater than that employed in primary production. Of the factories, more than 5500 are in the metropolitan area. A wide range of industry is covered, including textiles (almost entirely woollens) and clothing, the manufacture of which employs more than half the factory workers. Next in importance is the category of metal works and machinery, in which agricultural machinery, including the famous stripper-harvester, and railway requirements are included. Many factories are concerned with

primary products—for example, sawmills, tanneries, flour-mills, and butter factories. The production of electricity is under the control of a state Commission; the Yallourn station utilizes the brown coal deposits (exploited with German technical advice) for the supply of power to the Melbourne area and Gippsland. Hydro-electricity developed in connexion with the Sugarloaf reservoir and two near-by torrents is designed to serve the north-eastern section of the state. Even Corowa and Albury, in New South Wales, are served from this area. In connexion with the Yallourn enterprise considerable quantities of briquettes are now being manufactured. There are reserves of water-power on such rivers as the Mitta and the Snowy, but no local demand for power is likely to arise.

Towns and Communications. Victoria has a railway-system comprising nearly 5000 miles of 5 foot 3 inch gauge, and so well developed is it that, apart from the mountainous country in the east, only small areas of the state are beyond ten miles from the railway. The natural nodality of Melbourne and its central situation have led to a radial arrangement of lines from this centre, and it has already been noted that the connexions with the Murray lowlands allow it to tap the Southern Riverina.

The metropolitan area of Melbourne (estimated population, including such districts as Richmond, Brighton, Port Melbourne, and Williamstown, 1,018,200) holds considerably more than half the population of the state. The original settlement was seven miles up the Yarra from its mouth in Hobson's Bay, on the shores of which both Port Melbourne and Williamstown are located. Port Phillip, the drowned portion of a subsided area, has a narrow entrance; Melbourne, at its head, had easy access not only to the Great Valley, but *via* the low Kilmore Gap to the Murray plains. It was the obvious port of the gold areas that, lying to the west and north-west of it, played such an important part in Victorian development. Melbourne itself is chiefly used by inter-state shipping; liners generally use Port Melbourne, where 37 feet of water is available, while cargo vessels use Williamstown. The economic interests include milling and

woollen, leather, furniture, and iron industries, carried on mostly in suburbs such as Richmond, Brunswick, Williamstown, and Brooklyn, while its shipping, warehousing, commercial, and banking activities give it added importance. It notably deals with some 30 to 35 per cent. of Australia's wool

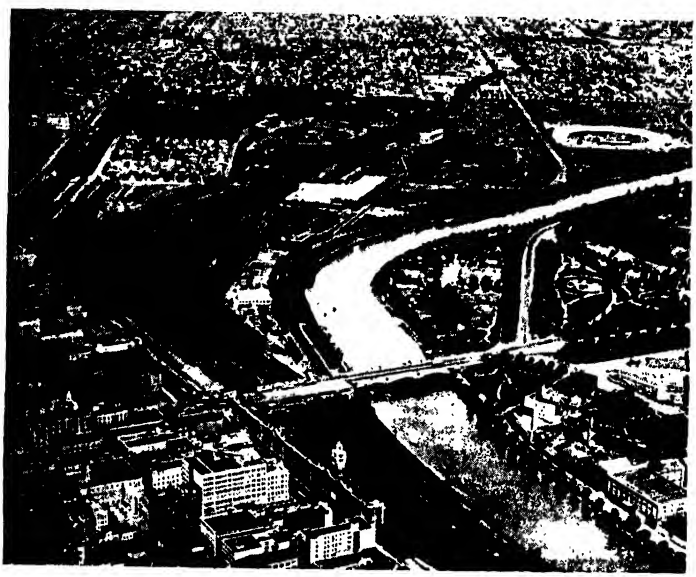

FIG. 94. MELBOURNE, SHOWING PRINCE'S BRIDGE, WITH FLINDERS STREET STATION IN THE FOREGROUND

Melbourne concentrates an extensive railway traffic.

By courtesy of the Development and Migration Commission, Commonwealth of Australia

export, and its development owing to its railway connexions has hindered the growth of any possible rival. In the immediate hinterland dairying and market-gardening are carried on, while residential and holiday districts are found on the east side of Port Phillip, notably Mordialloc (population, 9200) and Carrum (population, 7000).

The main line from Sydney enters Victoria *via* Albury, passes through Wangaratta (population, 4000), Benalla (population, 3300), and Seymour (population, 2100), all

typical centres in the mixed farming belt, and reaches Melbourne *via* the Kilmore Gap. Various branches run to Rutherglen (population, 1200), important for vine-growing, to Beechworth (population, 2550), where dredging for tin and gold is still carried on, and to Shepparton (population, 5000), largely a creation of the closely settled Goulburn irrigation area.

The line from Melbourne to Adelaide runs to Ballarat (population, 42,000), situated at 1416 feet, on the south slope of the highlands. The Ballarat district has produced gold to the value of £70,000,000, but this is of only historical interest. It is now largely agricultural, volcanic areas near by being particularly fertile; potatoes and oats are largely grown, and sheep reared. Ballarat, which is the largest inland city of Australia, is a market and commercial centre, with railway-workshops, woollen mills, and other factories, and, having a bracing climate, is a summer resort for the metropolis. Ararat (population, 5100), a pastoral, agricultural, and vine-growing centre, is reached just before the divide is crossed; then come Stawell (population, 4700) and Horsham (population, 4650), both in the Southern Wimmera, before the railway leaves Victoria at Serviceton. Ararat is also linked with Portland (population, 2800).

Bendigo may be reached through the Kilmore Gap or by the line passing near Mount Macedon and through Castlemaine (population, 7200), an old gold centre on the Coliban river, now of importance for wine and fruit, for slate-quarrying, and for its woollen and engineering industries. Bendigo (population, 34,000) still obtains gold from the 'saddle-reefs' and alluvial diggings, which have yielded £80,000,000 of the metal; it is served with water by the Coliban reservoirs, and irrigation in the neighbouring area allows fruit- and vine-growing, while early vegetables are sent to Melbourne. Foundries, potteries, tanneries, and railway-works are among its activities. To the west of Castlemaine is Maryborough (population, 5000), another old mining centre, with present-day agricultural interests. From here and Bendigo railway tentacles run through the Murray lowlands, notably (1) to Echuca (population, 4100), a wool

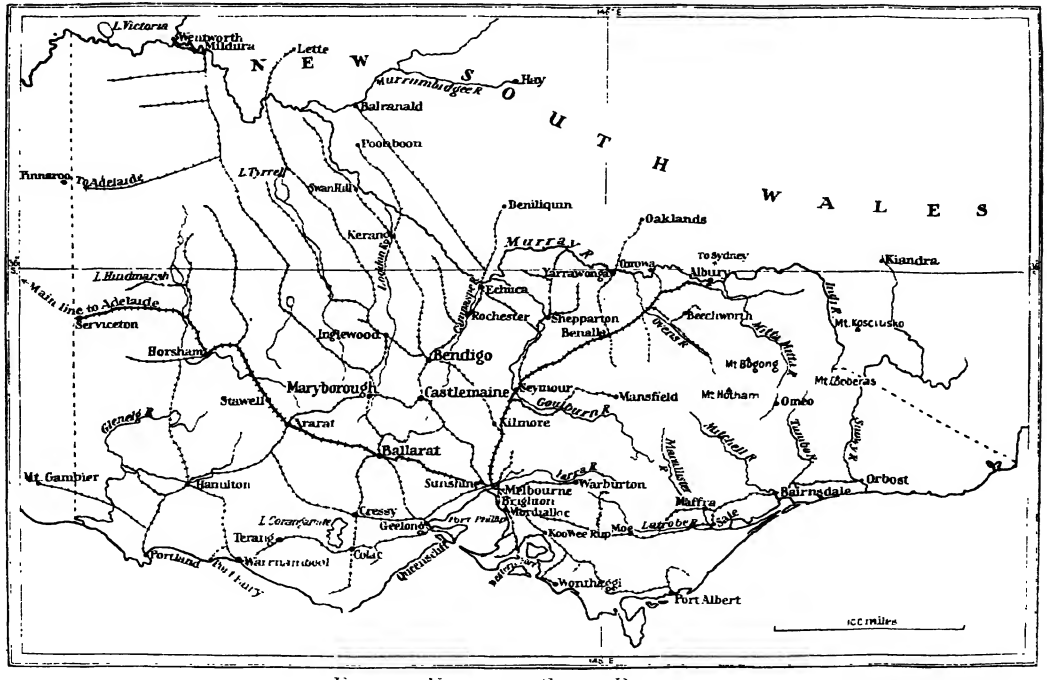

FIG. 65 VICTORIA—STATE RAILWAYS

With the co-operation of the New South Wales government, the Murray has been bridged at various places so that the Victoria state railways tap the border districts. They also penetrate into South Australia.

and irrigation centre on the Murray, at the normal limit of navigation, and now an important railway-crossing, (2) to the irrigation centres of Kerang (population, 2600) and Swan Hill (population, 2600), and (3) through the Mallee to Mildura (population, 6000), the important centre of the dried-fruit industry. From the last line a branch runs westward to Pinnaroo (just in South Australia), serving that part of the Mallee in which bores subserve the sheep industry.

The Gippsland line runs through Morwell (population, 1500) and near to Yallourn (population, 3000), in the Latrobe valley, on to Sale (population, 4000), with its irrigation products, and to the dairying town of Bairnsdale (population, 3600), a holiday centre on the Gippsland lakes. Branches link this line with the Mornington Peninsula, with the Wonthaggi coal-mining centre (population, 7000), and with Port Albert, a small centre in a dairying region. Worthy of note is the line from Melbourne up the Yarra valley to Warburton (population, 1200), the principal lumbering centre in the state.

Geelong (population, 43,500) is a notable port on the land-locked Corio Bay, on Port Phillip; behind it is the dairying Corangamite valley. It possesses woollen and tweed mills, as well as factories devoted to flour, leather, salt, cement, and paper. It can accommodate large vessels (29 feet of water), and its railway connexions with the sheep country *via* Ballarat and Ararat make it an important wool-broking city. Another port of note is Warrnambool (population, 8100), with agricultural and dairying interests, in the hinterland of which are such dairying centres as Colac (population, 4600), while through Hamilton (population, 5300), on the Wannon river, a tributary of the Glenelg, this port taps an area important for mutton and the western sheep and wheat districts beyond.

Trade. Normally Victoria does nearly 30 per cent. of the Commonwealth oversea trade. In 1927-28 imports were valued at £48,000,000 and exports at nearly £32,000,000. Of the imports, apparel, textiles, and manufactured fibres accounted for nearly £15,000,000 and metal manufactures and machinery for £12,250,000. Wool, of the value of more than

£15,000,000, provided nearly half the exports, which included wheat and flour (£2,750,000), butter (£2,500,000), and considerable quantities of dried fruits, milk and cream, and mutton and lamb.

Tasmania

This state stretches over about three degrees of latitude, 42° south latitude running roughly through the middle. It is situated on the continental shelf, and would be joined to the mainland if the sea should sink 200 feet. It includes a number of islands, of which King Island and the Furneaux group (Flinders and Cape Barren Islands) are the most noteworthy. Macquarie Island, far to the south-east, is rugged, but not barren. It is, however, only visited by sealers. The area of Tasmania, 26,215 square miles, approximates to that of Scotland, and the population, some 216,000 –about 8 to the square mile—has in recent years been almost stationary, a declining birth-rate and considerable emigration contributing to this. The aboriginal population is entirely extinct.

In 1798 Bass and Flinders proved Van Diemen's Land to be an island. The first settlement took place at Risdon, in the Derwent estuary, in 1803, and was followed by the establishment of Hobart the next year and of Launceston in 1806. Transportation to Tasmania persisted until 1853; free settlers first arrived in 1815. Wheat-growing was an early interest, and merino-breeding began in 1820. There was a prolonged struggle with the aboriginals, whose bers probably never exceeded 6000, the small remna being segregated in Flinders Island by 1835. In the meantime Tasmania had been constituted a separate colony in 1825; representative government came in 1851, and the first gold —which was not to play here the important part it did on the mainland —was worked in the following year. In the seventies and eighties came the mineral discoveries –copper, etc.—in the western districts. A feature of recent years has been the development of water-power.

Physical Features. The island is both topographically and geologically an outlier of the Eastern Highlands. The northern lowlands, which are not very fertile (except the

basalt flows and the Tertiary sediments of the Launceston basin), are overlooked by the Great Western Tiers, a name suggestive of the step-faulting that has taken place. The Tiers are the northern edge of the Central Plateau, the western edge of which is marked by Cradle Mountain (5096 feet) and Frenchman's Cap (4756 feet) and the north-east by Ben Lomond, with Legge's Peak (5160 feet). In the south a detached part of it rises to Mount Wellington (4166 feet), overlooking Hobart. The plateau consists of older Primary rocks, with much granite exposed; it sinks below the Derwent basin, which is filled with Permo-Carboniferous rocks. West of the Central Plateau are rugged highlands mainly composed of older Primary and intrusive rocks, but to the east and south-east of the island the surface is almost wholly occupied by rocks of Secondary age, including coal-measures.

The west coast is broken by Macquarie Harbour, into which flows the King river, through a remarkably deep gorge characteristic of this wild, bleak, and still little-known country. The rias of the Tamar and Derwent are further evidence of much subsidence. A belt of depression may be followed up the Macquarie (which when joined by the North Esk forms the Tamar) across to the Coal river, which drains to the submerged area round Storm Bay. On the Central Plateau immediately south of the Great Western Tiers is an area of many lakes. The Derwent rises in Lake St Clair (2400 feet), and receives by the Ouse river the drainage from the Great Lake—a shallow lake of about 50 square miles, at an elevation of 3800 feet—and by the Clyde that of Lakes Sorell and Crescent (2690 feet). Other rivers are numerous; of these may be noted the Arthur, in the north-west, the Gordon, flowing into Macquarie Harbour, and the Huon, flowing to the sunken south-east coast.

Climate and Vegetation. Mean climatic figures for Hobart show an annual range of temperature of 17° F., from 45·5° F. to 62·5° F., and an annual rainfall of 24 inches, well distributed. The temperature figures are similar to those of South-west England, and are typical of the lowlands of the island. Occasional frosts occur in the lowlands, and snow lies most of the year at the higher elevations. A warm ocean

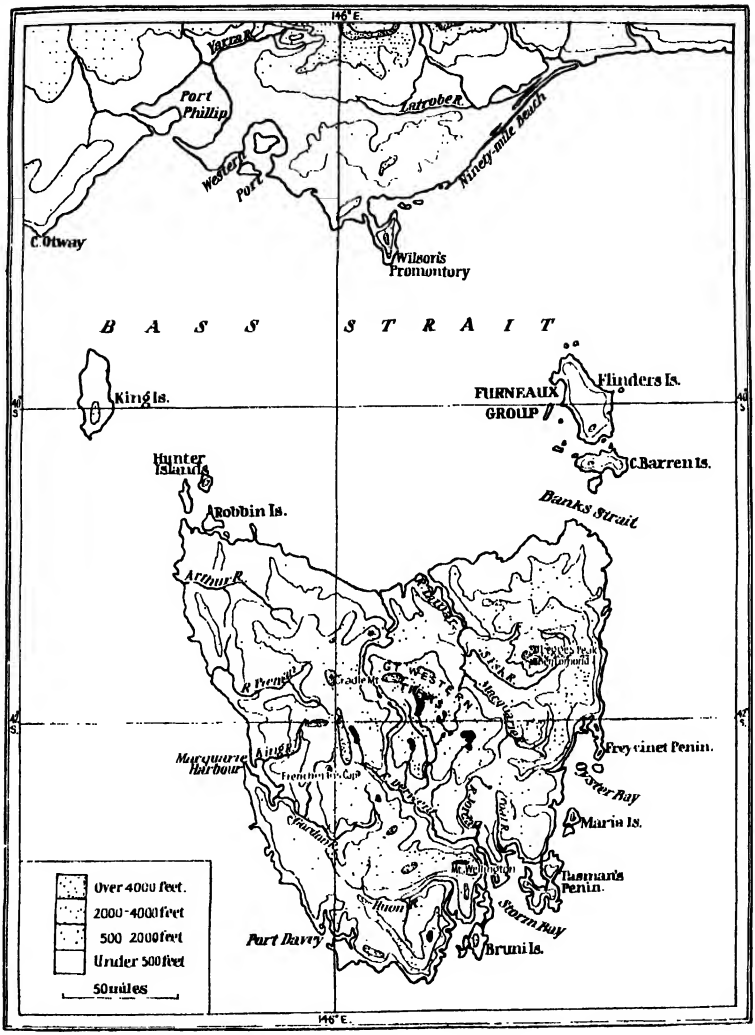

FIG. 96. TASMANIA—RELIEF

drift along the east coast gives that part temperatures several degrees higher than those of the west coast.

The island being constantly in the path of depressions from the west, the rainfall is such that serious drought is unknown, even in the lowlands. The effect of the relief is to give rise to wide differences in rainfall; Lake Margaret, in the hinterland of Macquarie Harbour, has 130 inches; the north-west lowlands have from 36 to 50 inches, the north-

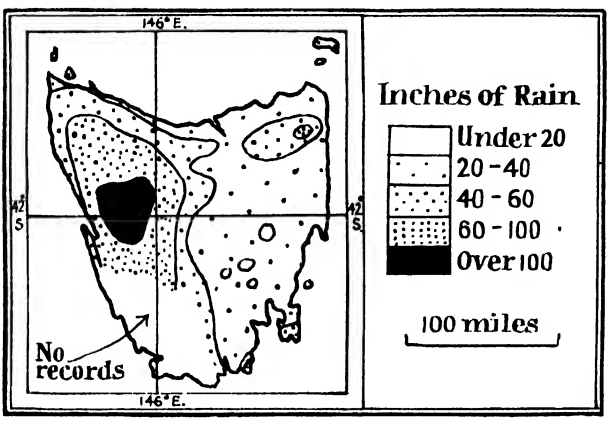

FIG. 97. TASMANIA—MEAN ANNUAL RAINFALL
Note the sharp contrast between east and west.

eastern highlands from 40 to 80 inches, and the midland districts north and north-west of Hobart average about 22 inches. The lowest rainfall, at Ross, where the main railway-line crosses the Upper Macquarie, is 18 inches. Evaporation, however, is much more rapid than in Britain, though the weather is characterized by similar rapid changes. In its temperate equability Tasmania is markedly distinguished from the mainland.

The heavy rainfall in much of the island might suggest that Tasmania is well forested, but large areas of wet and windswept highland are actually covered with scrub, grass, or bog regions of a moorland character merging into plant life of the mountain type. Nearly 9 per cent. of the area is

classified as forest, and large inroads have been made by wasteful cutting and by fires. Good forests occur in the wetter valleys, notably of the north-east and south-west. Most of the timber is hardwood eucalypt, varying from the swamp or blue gum to the mountain gum, and including stringy bark and blackwood, but there are also forests of

FIG. 98. SMELTERS AT ZEEHAN

Note the bleak country.

By courtesy of the Immigration Office, Commonwealth of Australia

beech ('myrtle'), and in the south-west Huon, celery top, and King William pines. Unfortunately, the forests are generally 'old,' and contain much poor timber. In the wetter valleys there is a good deal of undergrowth of tree-fern and laurel, but the forests of the drier eastern lowlands are of a more open type. In the midlands the plateau contains much grassland, used for sheep pasture.

Development. The population is distributed in Tasmania as unevenly as on the mainland, though the concentration in

the capital district is not so great as in mainland states, being only 26 per cent. Launceston has 13 per cent. of the total. The lowlands round the Derwent, Huon, and Coal rivers and the Tamar and parts of the northern lowlands are well populated; the midlands and the Macquarie-Coal river depression have a thinner population. There are scattered settlements along the east coast and mining concentrations in the north-eastern and western highlands, notably round Macquarie Harbour. Large tracts are unpopulated.

The relative stagnation in growth of population has given rise to a good deal of discussion, and there is much criticism of the result of federation upon the island and a demand for autonomy, especially as regards tariffs. It is claimed, for example, that the Commonwealth sugar policy results in Tasmania paying for this essential commodity a price 70 per cent. in excess of the world price. The shipping services are strongly criticized; much of Tasmania's trade is necessarily carried on *via* the mainland, and it is suggested that Australian shipowners with a monopoly of inter-state trade serve Tasmania inadequately. That the special position of Tasmania is recognized is shown by the granting by the Federal Government of special subsidies to the state finances.

Forestry is now receiving serious attention, and progress is being made in reafforesting reserved timber lands and in planting pines, notably in north-western and western districts. There are 170 sawmills, mostly small, which deal principally with hardwoods. There is a considerable local demand for boxes for packing fruit, and there was an export of timber, chiefly to the mainland, in 1927 28 valued at £351,000. The possibilities of paper-making, both from native hardwoods and from softwood plantations, are being investigated; an experimental plant has been set up near the Huon estuary, and Burnie, on the north coast, has been considered from the same point of view.

The large proportion of highland hinders the extension of the pastoral industry, and in this respect Tasmania differs from the mainland. In 1928 the island had 208,000 cattle, of which 94,000 were dairy cows; the proportion of the latter is increasing. Though found everywhere in the settled areas,

cattle predominate in the northern and north-western lowlands, where dairy cows and fat cattle are both important. The conditions of the northern coast favour a very large extension of dairying. The numbers of sheep are increasing, and totalled 2,000,000 in 1928; they avoid the wet western highlands, are few along the north coast (though of some importance between Launceston and Devonport), and are

FIG. 99. SHEEP SALES, TASMANIA
By courtesy of the Immigration Office, Commonwealth of Australia

chiefly found between 600 and 1500 feet on the pastures of the eastern half of the island, notably in the midlands and especially concentrating in the Derwent, Coal, and Upper Macquarie basins. There is at present little export of meat, but the wool clip is large, and the quality of some of the fine merino is extraordinarily high, though the bulk of the sheep are not pure merinos. The breeding of stud merinos is an important aspect of the sheep industry. A notable development is the great attention being given to the improvement of pastures by top-dressing.

The stock includes 35,000 horses and 48,000 pigs; in

connexion with the latter there are a number of bacon factories.

In comparison with the mainland states Tasmania has only a small cultivated area, but serious drought is unknown, and the average yield of crops is generally high. The acreage under wheat, chiefly grown near Hobart, shows little tendency to increase, largely because of mainland competition;

FIG. 100. APPLE ORCHARDS, TASMANIA

By courtesy of the Immigration Office, Commonwealth of Australia

in 1927 28 this crop covered nearly 30,000 acres, with an average yield of 26 bushels per acre. Oats suits the climate, and is the chief cereal crop—43,000 acres; it is generally grown in the northern dairying belt. Barley (5000 acres) is chiefly grown on heavy soils round Evandale, above Launceston. It is only to be expected that there is a large acreage under hay (mainly oaten hay) and other fodder crops. Potatoes (45,000 acres) are a large crop, especially on basaltic lands in the north-west and north-east, and a market is found for these, as well as for peas (24,000 acres), on the mainland.

The fruit industry is of considerable importance, and the climate is admirable for deciduous varieties, without recourse to irrigation. Apples (26,000 acres) dominate, the heaviest plantings being in the Lower Huon valley, in the lowlands in the immediate hinterland of Hobart, including Tasman's Peninsula, as well as in northern districts in the neighbourhood of Launceston and Devonport. Britain provides the chief market. There is a minor production of pears and apricots and small fruits in connexion with apple-growing, and hops have considerable importance in the Derwent valley.

The mineral resources of the ancient rocks are considerable and varied. In the northern hinterland of Macquarie Harbour the Mount Lyell Company produces principally copper in the Queenstown and Gormanston area. Farther north silver-lead and zinc ores are worked in the neighbourhood of Dundas—at Zeehan, Mount Read, Rosebery, and Tullah —while tin is important at Mount Bischoff, near Waratah. Power is developed for mining purposes and for the treatment of ores at Lake Margaret, on the Henty river, just north of Mount Lyell, and the metalliferous production of this area includes small quantities of gold, cadmium, and other metals. In the north-east is a similar but less productive area, notably in the neighbourhood of Gladstone, Mount Cameron, Derby, and Branxholm, in the Ringarooma valley, where tin is the chief product. Considerable reserves of iron, notably near Zeehan, Waratah, and Burnie, are hardly exploited. Osmiridium is worked in the south of the island. Coal, which is of a high ash-content, comes principally from the immediate neighbourhood of St Mary's. Limestone (for flux) is exported from Melrose to Newcastle (New South Wales), cement is important in Maria Island, and is worked for carbide manufacture near Hobart. The value of the production of the principal minerals in 1928 was: copper, £445,000; tin, £260,000; zinc, £190,000; coal, £107,000; lead, £101,000; silver, £80,000; osmiridium, £43,000; gold, £15,000. In 1929 most declined; copper, however, advanced to £740,000.

Tasmania, with no big local market and an isolated position, is handicapped in the development of factory industries.

Apart from woollen mills, located in the two large centres, manufacturing is confined to a few large enterprises and a number of small-scale establishments, dealing with a variety of products, including timber, fruit, butter, cheese, and leather. There is in addition much industrial work connected with the treatment of ores. In connexion with manu-

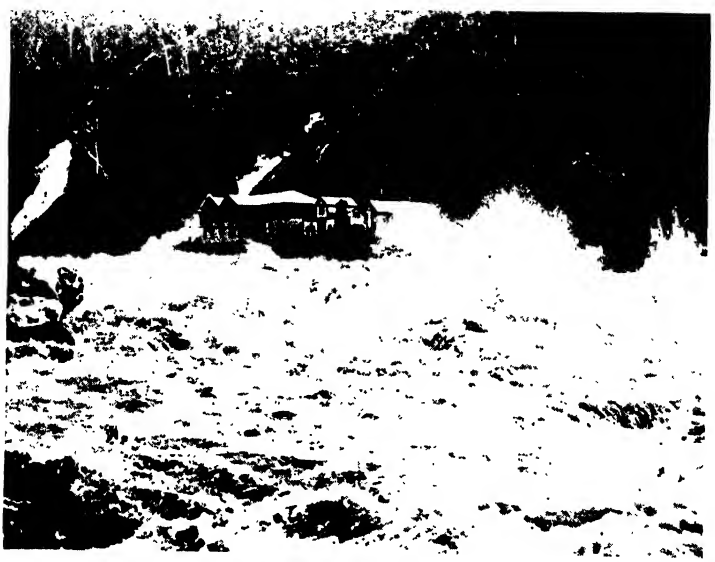

FIG. 101. CATARACT GORGE AND POWER-STATION, NEAR LAUNCESTON
By courtesy of the Immigration Office, Commonwealth of Australia

facturing development the electricity distributed from the power-station at Waddamana, utilizing water from the Great Lake, is of considerable importance. The horse-power available is 63,000, and a further 13,000 is harnessed on the Shannon river, in the same neighbourhood. The water-power resources are enormous, and surveys have been completed covering half a million horse-power, though development will probably be slow. Tourist traffic is of considerable importance to Tasmania, although the position of the island precludes any large number of visitors except from the

mainland. Perennially green with summer conditions that contrast favourably with the heat of the neighbouring con-

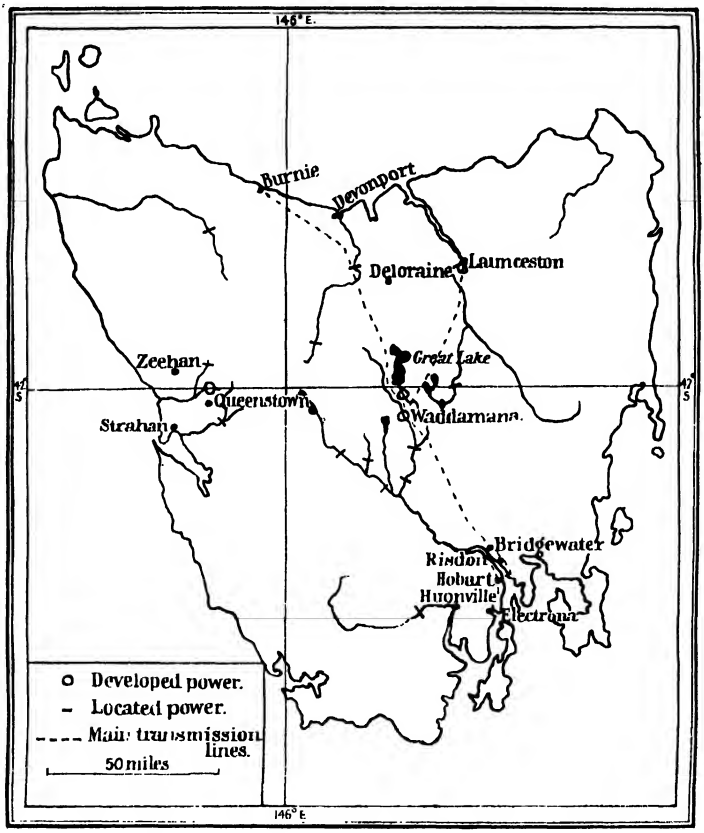

FIG. 102. TASMANIA -WATER-POWER RESOURCES AND HYDRO-ELECTRIC DEVELOPMENT

tinent, and with scenery that frequently achieves grandeur, the island is visited by many thousands of holiday-makers.

Towns and Communications. There are just over 800 miles of railway, all but 150 being state-owned. The main line, with several branches, follows the depression that links the

two principal cities; elsewhere there are a few short lines, chiefly serving mineral development. Apart from a number of magnificent estuaries, there are no navigable waterways, but the road-system is well developed in the more settled areas, while good roads penetrate here and there into more remote regions, largely to serve tourist traffic, notably the Scenic Reserve north of Lake St Clair. The variety of the

FIG. 103. HOBART, OVERLOOKED BY MOUNT WELLINGTON
By courtesy of the Immigration Office, Commonwealth of Australia

physical features has led necessarily to an uneven development of the island. The metropolitan district of Hobart, covering 86 square miles, has a population of about 57,000. It is situated on the west bank of the Derwent estuary, on low hills at the foot of Mount Wellington. The estuary, with deep water, is a splendid natural harbour, and Hobart is the principal industrial centre of the island, with woollen mills, sawmills, flour-mills, iron-works, and tanneries. More than half the trade of Tasmania passes through Hobart, and it is a port of call for liners running between Britain and New Zealand. Round the estuary are various places, some with

industrial interests based upon the supply of electricity from Waddamana. Most noteworthy is Risdon, where the Electrolytic Zinc Company deals with zinc concentrates from the

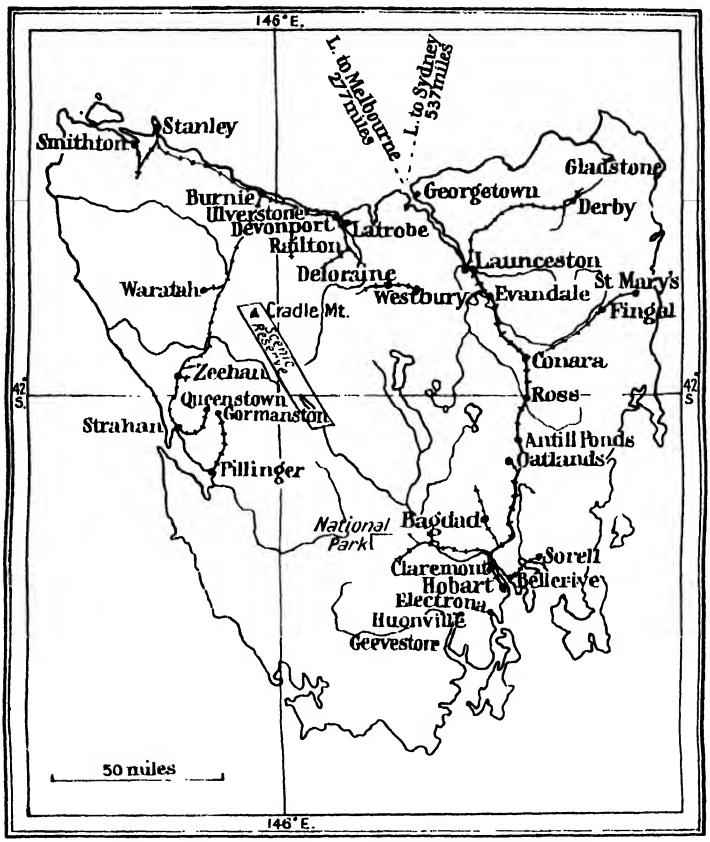

FIG. 104. TASMANIA RAILWAY DEVELOPMENT

west coast and from Broken Hill; an increasing quantity of cadmium is being refined here. There is a large chocolate factory at Claremont and a carbide works at Electrona. From Bellerive, opposite Hobart, a short railway runs to Sorell, a typical small settlement on Pitt Water, one of the

numerous inlets on this drowned coast. Other settlements of note in this part of the island are the apple centres of Huonville and Geeveston; a paper industry may be established at the latter place.

From Hobart the main line crosses the Derwent at Bridgewater, bends eastward to the Coal river, and follows this northward, passing through pastoral and agricultural country, including the driest part of the island; it crosses the Macquarie before running down through Evandale to Launceston. Launceston (29,000) is forty-one miles up the Tamar estuary, which is navigable for inter-state vessels to this point. As large vessels have difficulty in using the port the trade—about one-third of the total—is chiefly with the mainland. The town is supplied with electricity from a hydro-electric scheme at Cataract Gorge near by, and has similar industries to those of Hobart, besides smelting tin.

The branches from this main line are (1) from Hobart, following the Derwent valley, to the National Park, (2) northward up the apple-growing Bagdad valley, (3) from Conara up the South Esk valley to the coal-mining centre of St Mary's, (4) from Evandale westward through the dairying and agricultural centre of Deloraine (population, 1600) to Latrobe (population, 1700) and Devonport (population, 5000), the last a port with bacon and butter factories and a trade with the mainland in potatoes. West of Devonport are Ulverstone (population, 2800), with a short line running inland, Burnie (population, 4000), Wynyard, and Stanley. From Burnie a line runs southward—with a branch to Waratah (population, 1400)—through Zeehan (population, 2100) to Strahan, on Macquarie Harbour. Pillinger is another small port on this opening, with a railway serving Gormanston, in the Mount Lyell copper area, in which, however, Queenstown is the largest centre (population, 3200), connected by rail with Strahan. Smithton, in the north-west dairying region, has a short railway running inland, a railway also linked with the small port of Stanley. The mining district of the Ringarooma valley (with Branxholm and Derby) is served by a line from Launceston.

An air-service connects Northern Tasmania with Mel-

bourne; it is proposed shortly to continue the route to Hobart, and that later on a daily service will be in operation.

Trade. Exports in 1927–28 were valued at £10,000,000 and imports at £9,500,000. Only just over one-third of the exports were sent direct to markets outside the Commonwealth, and of the imports only £1,600,000 in value came directly from outside the Commonwealth. The rest of the trade is classified as 'inter-state,' but includes considerable quantities of trans-shipments, which emphasizes the dependence of the island on the mainland. The biggest export items were zinc (£1,500,000)—chiefly refined from imported concentrates—wool (£1,100,000), and fresh fruit (£1,050,000), but hides and skins, potatoes, tinned fruit, jam, timber, copper, and tin all reached considerable values. The imports included a variety of manufactured goods; metals and machinery (nearly £2,000,000), textiles and clothing (nearly £1,750,000), and foodstuffs (£1,750,000) were the most important.[1]

South Australia

With an area of 380,000 square miles (12·78 per cent. of the Commonwealth total), this state carries a total population of 580,000, just over $1\frac{1}{2}$ to the square mile. Its land boundaries are marked by the parallel of 26° S. and the meridians of 129° E. and 141° E., Adelaide being in latitude 35° S.

Although Captain Flinders had charted the Spencer and St Vincent Gulfs in 1802, it was Sturt's voyage down the Murray into Lake Alexandrina in 1830 that created interest in the area. The South Australian Association, formed in 1834, organized settlement on the lines advocated by Edward Gibbon Wakefield,[2] the outstanding feature of which was to declare the land public property, auction it, and utilize the money obtained to bring in labourers. A company formed for the purpose purchased land in 1836;

[1] These trade figures include the inter-state trade. For direct oversea trade see the Statistical Appendix.

[2] Gibbon's *A Letter from Sydney*, published in 1829, attracted great attention. He advocated the system indicated, and though he had never been to Australia, painted a glowing picture of the ease and results of colonization.

settlers were brought by two ships to Kangaroo Island, but, this being found unsuitable, they were removed to the mainland, where Adelaide was founded. The difficulties of the colonization, which had been ignored by the optimistic propaganda in England, soon led to insolvency, but the reconstructed colony made reasonable progress, assisted by the coming of the 'overlanders' from Sydney and by the discovery of copper in 1842 and later. A Legislative Assembly was established in 1850; the present Constitution dates from 1856. A serious crisis arose in the fifties, when thousands left the colony for the goldfields of Victoria and New South Wales. Following Stuart's journey across the continent, the boundaries were in 1863 extended to include Northern Territory. In 1911, however, the Commonwealth took over that region, and the area of South Australia was restricted. The development of the state has been mainly in the sphere of primary production, and has been limited by the large proportion of arid country and by the relatively small amount of irrigation possible. The construction of the trans-continental railway has brought South Australia into a central position in the Commonwealth system.

Physical Features. The structure of the western half of the state is comparatively simple, but crustal movements have in relatively recent geological times given a somewhat complex topography to the eastern part. The Western Plateau reaches to the Eyre depression and the Torrens rift, the highest elevation being Mount Woodroffe (5000 feet), in the Musgrave Range, where resistant masses of ancient crystalline rock are separated by wide valleys; to the south the Everard Range rises above the general level of the plateau, which is largely covered with Cretaceous rocks in the north-east and Tertiary limestone in the south, where it sinks to the Nullarbor Plain, marked by the Eucla Artesian Basin. East of the Musgraves are the stony 'gibber' plains, where flat-topped hills stand out, with sand-dunes, notably by the Alberga river. The Gawler Ranges, which do not reach 2000 feet, are separated from the main part of the plateau by a depression containing the saline marshes of Lakes Everard and Gairdner. The Eyre depression, declining

a few feet below sea-level, is part of the Great Artesian Basin.

Buckling has been responsible for the Lofty and Flinders

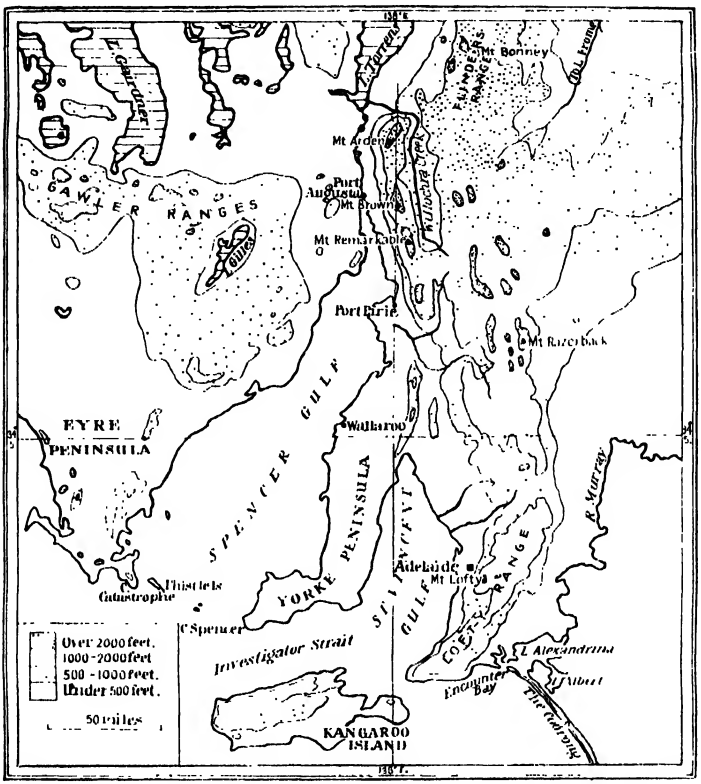

FIG. 105. THE TORRENS RIFT AND LOFTY FLINDERS BLOCKS - RELIEF

Note the steep escarpment on the eastern side of the rift valley and the plateau character of the highlands. Lake Torrens is fed in flood time by the Willochra Creek.

Ranges, which are horsts of Cambrian rock, and subsidence accounts for the important gulfs penetrating northward and the belt of depression traceable through Lake Torrens round the north of the Flinders Range to Lake Frome. The Lofty Range does not reach 2000 feet; Mount Benbonyathe and

St Mary's Peak, in the Flinders Range, rise to 3470 feet and 3900 feet respectively. The north-to-south arrangement of these relief features is notably important. The volcanic area of Western Victoria is continued into the Mount Gambier district, where a number of low cones occur.

Apart from the Murray, the rivers are unimportant. Only occasionally do the Alberga and Finke rivers and the Eyre, Cooper, and Strzelecki Creeks bring any considerable quantity of water into the Eyre depression, and there is no perennial drainage into the other 'lakes.' A number of short streams run to the St Vincent Gulf from the Lofty Range. The Murray flows for some 400 miles in South Australia, falling barely 60 feet, and meandering widely through alluvial lowlands, with a sharp bend in its general direction at Morgan, due to the Mount Lofty horst. It expands behind the Coorong sandspit into the lagoons of Lakes Alexandrina and Albert.

Climate and Vegetation. The mean monthly temperature of Adelaide ranges from 52° F. to 74° F. Apart from variations due to relief, mean temperatures increase northward, though not very appreciably in winter. The Eyre depression averages about 83° F. in the hottest month, but day temperatures are very high and the daily range considerable. Adelaide has only once shown a minimum of 32° F., though night frosts in the interior districts are not uncommon; snow on the higher parts is of only rare occurrence.

The rainfall broadly speaking declines from south to north, but the Lofty and Flinders Ranges, on the eastern side of the rift valley, standing athwart the depressions that bring the bulk of the rainfall, are of enormous importance in giving the settled part of the state a greater precipitation than would otherwise occur, besides carrying the tongue of moderate rainfall northward between the dry regions of Lake Torrens and Lake Frome. Adelaide has just over 21 inches, some 70 per cent. of which falls in the winter six months (May to October inclusive). This distribution is typical of the greater part of the state, only the northern part, where the rainfall is very meagre, showing a more regular distribution. Oodnadatta has barely 5 inches. More

than 80 per cent. of the state has less than 10 inches annually; this is the approximate rainfall of the northern part of the Bight coast, the amount increasing to about 25 inches in the southern part of the Eyre Peninsula. Port Augusta has 10 inches, a figure only slightly exceeded in the northern part of the Flinders Range. Yorke Peninsula has 15 to 20 inches, and the highest parts of the Lofty Range show more than 40 inches—the heaviest rainfall. East of the Lofty Range the precipitation increases southward from Morgan, with rather less than 10 inches, to Mount Gambier, with 31·5 inches, a place which reaps the advantage of a more southerly position. While the arid area suffers not only from deficient rainfall, but also from recurrent drought, the winter rainfall of the southern parts is generally reliable.

With such a large proportion of arid territory in the state it is not surprising that true forest covers only 0·2 per cent. of the area; it is mostly eucalypt, and found in the Lofty Range or in the extreme south-east, in the Mount Gambier area. Elsewhere in the southern areas mallee country, with mulga scrub and saltbush, covers parts with about 10 inches of rainfall. Except in the most arid regions there are stunted trees adapted to varying degrees of drought, and the native grasses and fodder plants permit the pastoral industry over most of the state.

Development. The population is particularly concentrated on the eastern side of the St Vincent Gulf and notably in the Adelaide area, which, with 325,000 people, contains 56 per cent. of the total, a larger proportion than in any state capital except Melbourne. The soils of the Adelaide plains, as on many parts of the Lofty Range, consist of fertile dark loams, and the rainfall is generally favourable to agriculture. The density of population thins out northward toward Lake Torrens and over Yorke Peninsula and again westward over the Eyre Peninsula and along the Bight coast. There is a fair density in the Murray lowlands and southward to the Mount Gambier corner. The arid part inevitably carries a very sparse population. There are about 3700 aboriginals and half-castes, largely in northern districts.

Steps are being taken to conserve what remains of the

natural forests, and a good deal of softwood planting has been undertaken in various parts of the south-east. There is a small production of eucalyptus oil (chiefly distilled on Kangaroo Island), as well as of wattle-bark and sandalwood.

South Australia has within its area portions of three artesian basins. In the north-east is part of the Great Artesian Basin, fringed by mound springs along the southern margins and yielding a dwindling supply of water at from 4000 to 5000 feet in the extreme north-east. The Murray Basin yields good supplies from shallow bores, but the Eucla Basin, in the south-west, gives salt or brackish water. There is a total of about 140 bores, many of which serve the pastoral industry in the north-eastern interior, particularly keeping open stock routes to the central railway from the Musgraves and South-west Queensland. Besides these, the small Adelaide Plains Basin yields a limited quantity of good water.

The western third of the state is almost devoid of stock, except for sheep, which penetrate along the Nullarbor Plain. There were in 1928 only some 263,000 cattle, of which about 115,000 were dairy cattle. The cattle are mainly in the east of the rift valley, and there is a notable concentration of dairy cattle near Adelaide and again in the Mount Gambier corner of the state. Sheep, numbering in 1928 about 7,000,000, are more restricted in distribution than cattle, and are very few in the northern areas, even in the Great Artesian Basin; they are notably numerous in the rift valley, on the Mount Lofty Range, and in the extreme south of the state. Of beef and mutton South Australia has only an insignificant surplus, and little butter is exported; wool, on the other hand, is a staple product. Pig-rearing and poultry-keeping have importance in the neighbourhood of Adelaide, and nearly 4500 camels serve transport in the interior.

Wheat-growing has been important since the earliest days of settlement, and no part of Australia shows a greater concentration of this crop than the area between the Lofty Range and Spencer Gulf, including all but the southern part of the Yorke Peninsula, where the wheat-sheep combination is commonly followed. The 10-inch isohyet limits the wheat-

growing area, which by extensive and dry-farming methods has spread into the Murray-mallee area and from the Eyre Peninsula along the Bight coast nearly to the Head of the Bight, as well as along the highlands northward to the southern part of the Flinders Range. Comparatively little wheat is found in the south-east corner, where more attention is given to hay and fodder crops for the dairying industry. As has been pointed out, the winter rainfall favours this crop; 3,000,000 acres were under it in 1927–28; and the acreage per head of population is higher than in any other state except Western Australia. The yield in the districts away from the rift valley is not generally very high; the average for the state in 1927–28 was 8·16 bushels per acre, to be compared with 12·84 in the previous year.

Some two-thirds of Australia's barley area is in this state, where the acreage in 1927–28 was just over 200,000. It is chiefly malting barley, and more than half the state's crop is located on the poorer soils of the southern part of Yorke Peninsula. Oats, with a still smaller acreage, is mainly grown in the Eyre Peninsula and in the mallee country in the angle of the Murray. There are large areas under wheat and oats for hay, but lucerne has little importance. It is notable that almost the whole of the area under sown grasses is divided between the immediate hinterland of Adelaide and the south-eastern corner—that is, the principal dairying districts.

Vine- and fruit-growing are important on the limited irrigation areas. The principal irrigation area (23,000 acres, of which 7700 acres are irrigated) is at Renmark, on the Murray. Next in importance are the Berri and Waikerie districts, situated about 120 and 40 miles respectively above Morgan, and there are a number of smaller schemes. Below Morgan there are along the Murray a number of small areas of reclaimed swamp land, the most notable being at Mypolonga, a few miles above Murray Bridge, and at Jervois, about twenty miles below this point. The irrigated districts, in which the soils are chiefly sandy loams, are mainly devoted to vines (largely for raisins, but also for wine) and fruits, notably oranges, pears, apricots, and peaches; the reclaimed areas are mostly given over to fodder. With the assistance

of the Lake Victoria storage and the Murray locks it is hoped to extend the irrigation, and operate much of it on the gravity system.

The vine and fruit production of these areas is far exceeded by that of the rift valley, where, however, the vines are mainly for wine. This is an orchard land of the Mediterranean type. Adelaide County leads in the production; the lowlands and valleys grow oranges, lemons, figs, peaches,

FIG. 100. VINEYARDS AND WINERY, SOUTH AUSTRALIA

By courtesy of the Development and Migration Commission, Commonwealth of Australia

apricots, and almonds, and the lower slopes of the Mount Lofty Range have extensive vineyards, olive-groves, and apple orchards. South Australia is the leading wine state, and the production, under the stimulus of the bounty, is large. Great Britain provides the principal market. Brandy is also distilled. In 1927–28, of a total of 46,500 acres under the vine, 27,000 acres (mostly for wine) were in the Adelaide and adjacent districts, and nearly 17,000 acres in irrigated districts; of 27,000 acres bearing orchards the respective figures were 19,000 and 4500 acres. A certain amount of small-fruit cultivation is carried on in connexion with the market-gardening developed near the capital city.

The total number of men employed in mining has in no

recent year exceeded 1000. There is mineral wealth in considerable variety, but it is generally costly to work on a large scale. Of the metals copper as recently as 1923 provided an output valued at nearly £250,000; the 1920 production reached barely £23,000. The only ore largely worked is iron ore, in the hæmatite of Iron Knob. In 1928 the output was 620,000 tons, providing the bulk of Australia's production. Of other minerals salt is the most important. It is obtained not only by the evaporation of sea-water at the head of each of the two gulfs, but largely from the salt lakes of the southern end of Yorke Peninsula, as well as from others farther north—*e.g.*, Lake Hart, north-west of Port Augusta. The output was valued at £160,000 in 1928. Gypsum is extensively worked in the south of Yorke Peninsula, while opals are obtained from a rich field in the Stuart Range. Considerable quantities of sub-bituminous coal and lignite are known to exist, but because of poor quality or remote position are unworked; thus coal is known in the interior north of Port Augusta and brown coal near the head of the St Vincent Gulf and in the Murray basin.

Manufacturing industry is not widely developed. Textiles and engineering works have grown in the suburbs of Adelaide, and there are important smelting works at Port Pirie dealing with the Broken Hill silver-lead ores. Flour-milling is carried on at the wheat ports, and many factories have arisen in connexion with other primary products.

Towns and Communications. Large areas are inevitably served neither by roads nor by railways. The total length of railways within the state is about 3800 miles; this includes state lines, Federal lines, and a short private line from Iron Knob to Whyalla. The earlier state lines were of 3 foot 6 inch gauge; later lines, notably those to serve the mallee country, were of 5 foot 3 inch gauge. The Federal line from Port Augusta to Alice Springs, of which about 600 miles are in the state, is of 3 foot 6 inch gauge (it was originally a state line as far as Oodnadatta), while the Federal trans-continental line running westward from Port Augusta, with about 600 miles within the state, is of standard gauge. The state's direct interest is therefore in the south-east and the Eyre

Peninsula. There is a fairly close network in the more settled area, especially of north-south lines, as is to be expected from the trend of the physical features, but several railways cross the Lofty Range, utilizing cols, though the main line into Victoria crosses at nearly the highest point. While there is a concentration of lines upon Adelaide, there are other terminals, notably Wallaroo, Port Pirie, and Port Lincoln, while Port Augusta is likely to become an important centre in the future, when the unification of the continental railway materializes. The penetration of the two gulfs into the fertile area is responsible for this development.

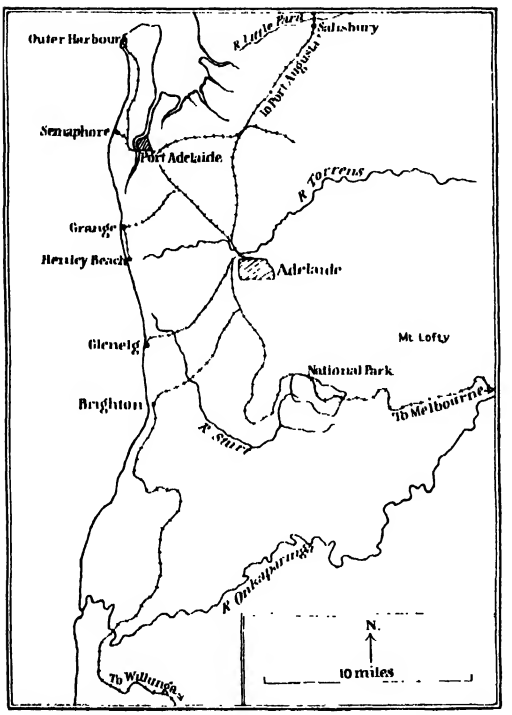

FIG. 107. THE P[illegible]ON OF ADELAIDE

Apart from Adelaide with its suburbs, only Port Pirie, with nearly 10,000 inhabitants, had at the end of 1928 a population exceeding 4000. The metropolitan area of Adelaide covers 215 square miles, and includes Port Adelaide, Glenelg, and other suburbs, with a total population of about 325,000. The original settlement was located on rising ground by the Torrens stream, a few miles inland from Holdfast Bay, but the deep-sea outlet was established on an estuary, about seven miles to the north-west, which

has been improved by dredging and by the construction of an outer harbour to accommodate liners that reach this part of Australia *via* Suez. Reservoirs in the highlands provide the water-supply, and there is a development of tourist resorts both in the highlands and along the coast. The immediate hinterland and the railways to Victoria and the Murray give Adelaide the leading position in the trade in grain, wool, dairy products, wine, and fruit, while industry is represented by woollen mills, engineering-works, cement-works, breweries, tanneries, and factories devoted to a variety of other products. Adelaide serves the Lower Murray; a port which it has been suggested should be developed at the entrance of the river, with improved navigation upon it, would doubtless tap much of this trade, but is unlikely to materialize in the near future.

The line to Port Augusta passes through Gawler (population, 1750), with small industries connected with agricultural implements, flour, and brewing, and Terowie, where the gauge changes from broad to narrow. At Peterborough (population, 3400) the line crosses that from Broken Hill to Port Pirie (population, 9500), which not only deals with silver-lead ore, but handles much wheat. A number of branches serve the productive hinterland of Adelaide, such as those to the wine centres of Angaston and Clare, to Morgan, on the angle of the Murray, and through Kadina (population, 2400) to Wallaroo (population, 3200), once producing large quantities of copper, but now chiefly important as a grain port. The line to Melbourne passes Mount Lofty, crosses the Murray at Murray Bridge (population, 3600), which serves the Murray settlements, and goes on to Tailem Bend before passing through the poor limestone and sandy region that separates the mallee from the productive south-east corner of the state. At Tailem Bend railways converge from several irrigation settlements on the Murray and from the Victorian mallee, and so serve Adelaide with dried fruit, wheat, and wool for export. Mount Gambier (population, nearly 4000), in a district of good rainfall and rich volcanic soils, is the chief centre for an area which includes Naracoorte (population, 1600), famous for dairying and fruit-growing;

Mount Gambier itself is connected with the wide-gauge Victorian system, but the area is served by narrow-gauge lines. Crater lakes and a relatively cool summer climate give the district tourist importance.

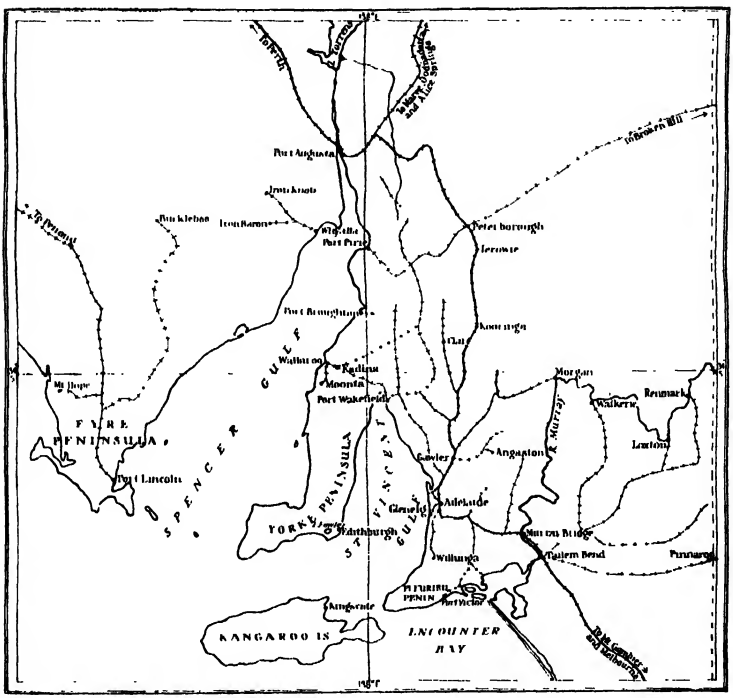

FIG. 108. SOUTH AUSTRALIA PRINCIPAL RAILWAYS

Red Hill, north of Port Wakefield, is the present terminus of the line that covers half the distance between Adelaide and Port Augusta; see next page.

Yorke Peninsula is without railways; Edithburgh's importance is connected with its salt-works.

Port Lincoln (population, 2600) has a good natural harbour, better than most in the state, and serves the wool- and wheat-growers of the Eyre Peninsula and, by means of a narrow-gauge railway which reaches Penong, the developing country which stretches in the coastal belt toward the Head of the Bight.

Port Augusta (population, 1400) has only a limited development; it serves an area in which the rainfall is not large enough to favour any intensive development of wheat-growing or stock-rearing. It deals with wheat, wool, and cattle; the railway to Alice Springs is marked by small settlements, and is fed by stock routes which pass through territory that can be only lightly stocked. Among the settlements may be noted Leigh's Creek, in the neighbourhood of which both coal and iron are known to exist, Farina, served by a stock route from South-west Queensland *via* Strzelecki Creek, Marree, similarly served *via* the Diamantina river, and Oodnadatta, for long the terminus of the line, to the west of which the cattle industry has been helped by recent boring for water.

The trans-continental line from Port Augusta crosses the head of the gulf at Yorke's Crossing, soon enters the country of salt lakes lying north of the Gawler Ranges, and reaches thinly stocked sheep country in the neighbourhood of Tarcoola, beyond which the red soils of the plain carry a certain amount of timber. Farther on is a region of sandhills bound together by a more or less thick growth of small trees and scrub, and the treeless limestone Nullarbor Plain, with saltbush and blue bush, is entered at Ooldea.

The finances of all lines are affected by fluctuations in the amount of traffic due to seasonal variations in production, while motor-traffic now provides considerable competition, but the interior lines are necessarily unremunerative. Goods traffic on the trans-continental line is still small, but will doubtless develop with unification of gauge. In time sheep-rearing will increase and possibly wheat-growing develop along its route. The steps contemplated in South Australia to improve the trans-continental route include the continuation of the standard-gauge line from Port Augusta to Red Hill and the laying of a third rail on the wide-gauge track of the line that at present exists from that point to Adelaide. The present changes at Terowie and Port Augusta will thereby be obviated.

Trade. Of oversea exports, in 1927 28, totalling nearly £18,000,000, wool led at £4,900,000, and wheat followed at

£4,600,000. The mineral export, chiefly lead, silver, and concentrates *via* Port Pirie, was valued at about £4,400,000. Other important items were flour, wine, and hides and skins at about £800,000 each and fruits at nearly £600,000. Oversea imports totalled £12,500,000, metal manufactures (largely machinery and motor vehicles) accounting for £4,750,000 and textiles and apparel for £2,250,000, while oils, timber, bags, and sacks figured prominently.

Western Australia

With 975,920 square miles, this state is the largest, and covers almost one-third of the continent. Some 37 per cent. of the area is within the tropics. With an estimated population of 417,000 (excluding some 23,000 aboriginals and half-castes, who are found in most parts, but are most numerous in the savanna and north coastal districts), there is a mean density of about 0·43 to the square mile, which illustrates the uninhabitability of much of the country, as well as the lack of development of other parts. Its eastern boundary is the meridian of 129° E.; elsewhere it is bordered by 4350 miles of coastline, with a general outlook on the Indian Ocean, so that, though remote from the more developed part of the continent, it has the advantage of being nearer to the important Suez route.

It was visited successively in the seventeenth century by the Dutchmen Dirk Hartog, Pieter Nuyts, and Willem de Vlaming (the last of whom explored and named the Swan river in 1696), and also by William Dampier. Their reports gave no encouragement to settlement, though many names along the coast bear witness to their visits, as well as to those of later French explorers. Definite British interest dates from 1791, when George Vancouver formally took possession of the south-west corner. Matthew Flinders sailed along the south coast in 1801, and the surveys of Phillip King were followed a few years later by a military settlement—through fear of French penetration—at Albany in 1826 and the foundation of Perth in 1829. The settlement of this virgin and unknown land by the Swan river, however,

was not easy; the land occupied was generally poor and forested; Grey's discoveries of good pastoral land to the north were remote; while Eyre's journey across the Nullarbor Plain offered no prospect of development in that direction. With barely 6000 people in 1850, the settlers offered to receive convicts, and transportation went on until 1868. Real progress followed the journeys by the brothers Forrest and others, but although gold had been earlier discovered in the Kimberley area (1885) and at Yilgarn (1887), it was the finding of the Coolgardie field in 1892 that brought thousands, including many from the east, to Western Australia. The population rose to 180,000 by 1900 (having nearly quadrupled in ten years), by which time the gold-production was approaching its maximum, and farming had become a more serious preoccupation. More recently the state has shown relatively a more rapid development than any other; indeed, the increase in population since 1920, amounting to nearly 100,000, has been largely at the expense of the east. For this wheat-production has been largely responsible.

Physical Features. The greater part of the state is an elevated plateau. A coastal lowland of varying width generally rises gradually to the plateau, except in the south-west, where the Darling Range presents a steep faulted edge for 100 miles north to south and where Cape Leeuwin and, farther east, the Stirling Range present similar escarpments. The ancient rocks of the plateau reach the sea only along the western half of the south coast. In other places the plateau is flanked by rocks of Secondary age, with Tertiary and even later deposits along parts of the coast.

The plateau is diversified as the result of differential erosion and of differing degrees of aridity. The average elevation is about 1200 feet; in only a few areas is 2000 feet exceeded, notably in the Hammersley-Ophthalmia Plateau, much of which is over 3000 feet, where Mount Bruce (4024 feet), the highest point in the state, overlooks the Fortescue valley. The block of the Stirling Range rises to 3640 feet in Bluff Knoll, but Mount Cooke, the maximum elevation of the Darling Range, is only 1910 feet. In the Kimberley

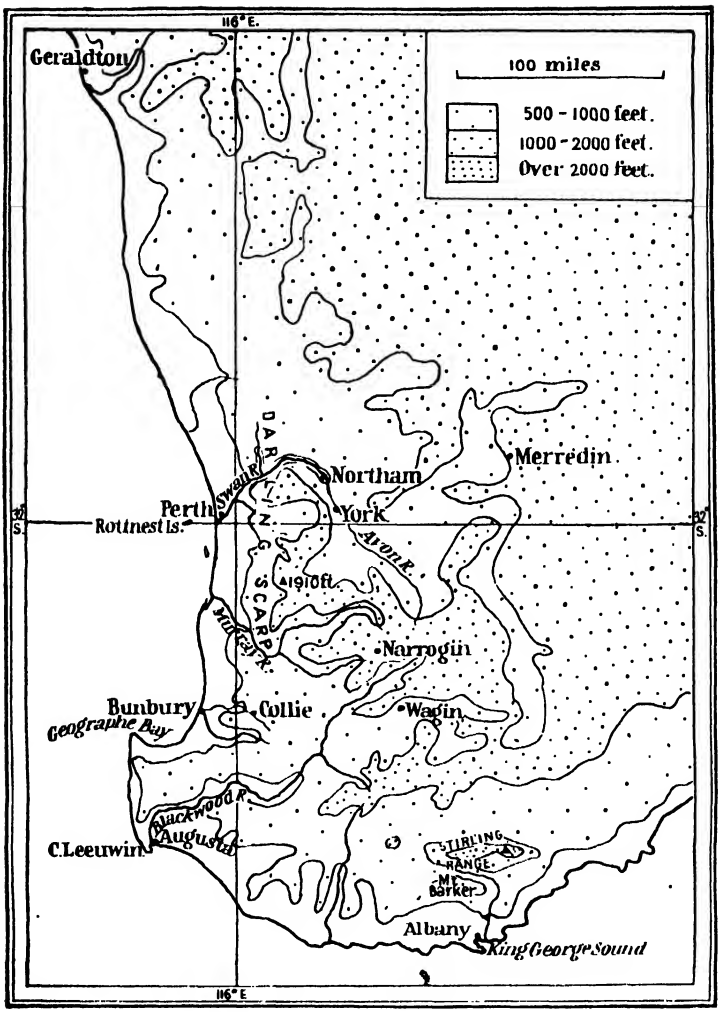

FIG. 109. THE SOUTH-WEST OF WESTERN AUSTRALIA—PHYSICAL

The Darling Range, though an outstanding feature, does not reach 2000 feet; behind it, Northam and York are important agricultural centres.

Division, where Mount Hann reaches 3800 feet, rivers have much dissected the plateau, and broad valleys also diversify the generally undulating North-west Division. The Darling escarpment and the region behind it have been cut up by the considerable rainfall of this area (often called Swanland). The arid central part is largely marked by stony desert and low sand-ridges running east to west and bound together by spinifex and other drought-resisting growth, with occasional ridges of harder rock ('breakaways') and areas of granite. In the south-west quadrant of the plateau is a region of hollows occupied by salt lakes often linear in shape and probably relics of the drainage of an earlier and wetter period, the valleys having been blocked by advancing sand-dunes as the climate became more arid.

In the south-west corner the plateau dips gently to the Nullarbor Plain, where Cretaceous limestone is overlaid near the Bight by Tertiary deposits that reach the coast in cliffs about 200 feet in height.

Vertical movements, mainly subsidence, account for the development of gulfs in the Kimberley Division (where the tidal range at some places exceeds 40 feet) and the North-west Division, where many islands, often fringed with coral, occur. Elsewhere important features, such as the Swan estuary, Geographe Bay, and King George Sound, are also due to subsidence.

There are many considerable rivers in the north, bringing down great quantities of water in summer; only a few are perennial. The Ord and the Fitzroy are the most important, and their valleys could supply the water needs of a large population. In the North-west Division the rivers depend upon a smaller and more variable rainfall. In the south-west there are perennial rivers with a winter maximum flow, the most notable being the Swan, which rises, with a number of tributaries, well behind the Darling Range.

Climate and Vegetation. Temperatures vary from those of a warm temperate to those of a tropical character. Thus the mean annual temperature at Perth, 64° F., compares with 83° F. at Wyndham. Mean monthly temperatures at Perth range from 55° F. to 74° F.— very characteristic of the south

of the state—at Wyndham from 76° F. to 86° F. Temperatures broadly speaking increase from south to north, except that in summer the Great Sandy Desert, lying in the hinterland of Ninety-mile Beach (where Marble Bar had in 1921–22 103 successive days with the maximum temperature exceeding 100° F.), shows the highest temperatures in the continent. The interior shows the usual increase in daily and annual ranges as compared with the coast, and the low humidity and general absence of cloud causes night frosts, which are not uncommon in inland northern districts, but are unknown at Perth.

Nearly half the state has less than 10 inches of rain, this very dry area stretching along the eastern boundary from about latitude 21° S. to the Bight coast and narrowing westward to Shark Bay, where Carnarvon has barely 9 inches. Evaporation, which is considerable everywhere, is excessive in the interior, where at Laverton, with a rainfall not reaching 9 inches, the evaporation is equivalent to 142 inches.

The region of maximum winter rainfall brought by eastward-moving cyclones marks the south-western portion of the state and extends up the western littoral as far as the Fortescue river. Elsewhere, except in the driest part of the state, where the rainfall is sporadic, the rainfall is of the summer type and dependent upon the monsoon. Perth, with 34·5 inches, receives nearly 30 inches between May and October inclusive, and is in a region where the relief, as in South Australia, promotes a good and relatively reliable rainfall. In a few isolated places in the extreme north the rainfall exceeds 40 inches, but this rapidly diminishes southward; Wyndham has 29 inches, Broome 23·5 inches, Hall's Creek (near the most elevated part of the Kimberley Division) 21 inches, and Nullagine 14 inches. Much of the rainfall is of a violent character, notably when the 'willy-willies' come. In the winter rain area, where the amount rapidly declines away from the coast, typical figures range from 8 inches at Onslow, 9 inches at Coolgardie, and 10 inches at Eucla to 17·5 inches at Katanning, on the inland side of the highland of the south-west, and 34·5 inches at Perth, while a coastal area stretching from Cape Leeuwin nearly to Albany and the

seaward-facing Darling Scarp have over 40 inches—more than 50 inches in parts.

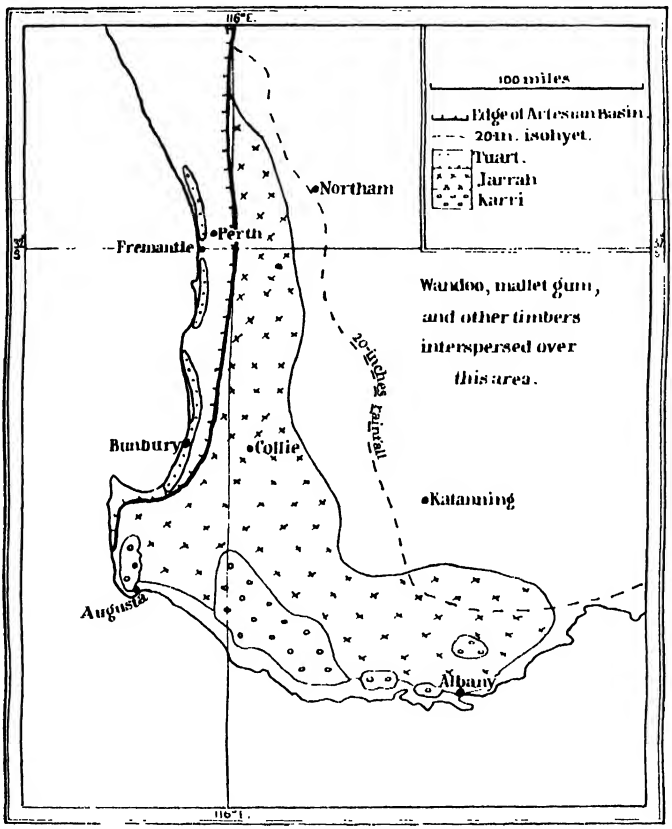

FIG. 110. DISTRIBUTION OF TIMBERS IN THE SOUTH WEST OF WESTERN AUSTRALIA

Karri is found only in the wettest districts.

From a Western Australia Government map

In the north the actual rain forest is limited to the wetter river-valleys, with mangroves along parts of the coast. The prevailing country is savanna in type, with good grazing where the rainfall exceeds about 20 inches. Farther south

the tree-growth changes from eucalypt to mulga scrub, which merges southward into the sand-ridge desert with desert gum, scrub, and spinifex. The desert reaches the Indian Ocean in the neighbourhood of Ninety-mile Beach, south of which are scrub lands, which mark the country round the Fortescue, Ashburton, and Gascoyne rivers. The forest improves until about latitude 31° S. there comes a coastal belt of tuart, with jarrah on the plateau, merging eastward in the drier parts into open woodland, with various gums, notably wandoo (white gum), York gum, and red gum, while other eucalypts are met with as the country shades into scrub of the mallee type. Saltbush is characteristic of the Nullarbor Plain. Karri is limited to the wettest part of the extreme south-west.

Development. The north lacks any intensive development, and most of the area with less than 10 inches of rain is useless even for pastoral purposes, so that the population inevitably concentrates in the south-west corner, where the climatic conditions favour agricultural development. The metropolitan area of Perth, which includes Fremantle, and covers 137 square miles, has nearly 203,000 inhabitants, about 48 per cent. of the total in the state. No town outside this area reaches 6000. A large proportion of the country is without white population, and away from the network of railway development in the south-west the largest concentration is in the Boulder-Kalgoorlie mining area.

The accession of population notable in recent years has largely gone into the wheat belt behind the Darling Range, and the importance of primary production and relatively slight development of secondary industry have been accompanied, as in Tasmania, by severe criticism of the effects of federation. Again like Tasmania, Western Australia receives a special subsidy from the Commonwealth finances.

Western Australia is the chief Commonwealth exporter of hardwoods, the principal one being jarrah, which is a magnificent eucalypt growing chiefly in laterite soils on the Darling Range and eastward to Albany. Karri is a much taller eucalypt, of even greater strength, but of much more circumscribed habitat, and, unless treated, less resistant

when used in the ground or in water. Tuart, growing on a narrow limestone belt stretching from Perth to Geographe Bay, is extraordinarily tough and dense, but the quantity

FIG. 111. KARRI

Karri sometimes approaches 300 feet in height.

By courtesy of the Immigration Office, Commonwealth of Australia

available prohibits export. Wandoo is another useful eucalypt, which does not, however, grow in forests, but is scattered over the south-west. A large amount of timber is available for mining work and fuel in the regions stretching out toward the Eastern Goldfields, where sandalwood and mallet gum (yielding tanning bark) are found and exported. As elsewhere, reckless clearing and forest fires in the past

have led to conservation efforts, and as softwoods are lacking, conifer plantations are being developed.

Artesian water has great importance. There are five artesian basins, with a total of about 240 bores, some 50 of which are in the metropolitan area, where the water of the Coastal Plain Basin is fresh, though farther north it is suitable only for stock. The Eucla Basin has been little investigated, but there are about 100 bores in the North-west or Carnarvon Basin, serving excellent sheep country. The large Desert Basin is little developed, though Broome and Derby get supplies from it. Wyndham is served from the Gulf Basin. In much of the interior shallow supplies of usually saline water are available, and stock routes are kept open with their help. The Eastern Goldfields water-supply scheme is an important undertaking; the Mundaring reservoir, in the Darling Range, twenty-six miles east of Perth, has a capacity of 4,650,000,000 gallons, and the water, after being pumped up by stages to a sufficient height, serves by gravity not only the Boulder-Kalgoorlie area, but a number of townships *en route*.

The physical conditions do not generally favour extensive irrigation, though there are possibilities of this in the north-west. In the south-west there are many small-scale private schemes, and there is one irrigation district of 4000 acres at Harvey, on the Hamel river, some distance south of Pinjarra, largely devoted to oranges.

At the end of 1928 cattle numbered about 840,000, fully two-thirds of which were on the northern savannas, especially in the basin of the Fitzroy and Ord rivers, in the hinterland of Broome, Derby, and Wyndham. Elsewhere cattle are relatively thinly scattered over the western half of the state, with some greater concentration in the South-west Division, where almost all the dairy cows (numbering 70,000) are located. Dairying therefore has at present less importance than in any other mainland state, but the conditions in the coastal belt from north of Perth round to Albany are very favourable, and the industry is expanding.

Sheep, numbering about 9,000,000, are increasingly reared in the wheat belt of the south-west; elsewhere they are

important in the scrub lands behind Geraldton and round the Gascoyne, Ashburton, Fortescue, and De Grey rivers, where the stations are very large, that at Millstream, in the Fortescue basin, covering 1200 square miles. While there is an export trade in beef (which amounted to £136,000 in 1927–28), there is little or no surplus of mutton, though wool is naturally a staple export.

The number of horses is declining, but breeding is important on the northern savannas and in the Albany district. Pig-breeding shows no outstanding development. The number of camels (about 4000) and of mules and donkeys (9500) is suggestive of the type of transport that is still important in the interior.

Among animal products that contribute to the export trade are hides and skins, not only of sheep, but also of the rabbit and opossum.

The adjacent seas are notably rich in fish, but the resources have not been properly investigated nor developed on any large scale. Whales visit both the western and southern coasts, and oil factories have been operating at Port Cloates (south of North-west Cape) and Albany. More important are the pearl-fisheries of the northern coast, where diving in fairly deep water—down to 25 fathoms—is carried on; the luggers operate chiefly from Broome, but also from Port Hedland, Cossack, and Onslow. There is a smaller fishery at Shark Bay. Turtles and dugong (a herbivorous mammal with a thick hide and palatable flesh) are plentiful in the warmer waters. In 1928 the value of pearl shell and pearls obtained was respectively £146,500 and £22,400.

Wheat is by far the leading crop, covering 3,000,000 acres in 1927–28. The acreage has more than trebled since 1920. The crop is confined to the south-west, and avoids the coastal belt and the high rim, but stretches eastward through the jarrah belt to the longitude of Southern Cross and northward in a narrowing belt toward Geraldton. With dry-farming methods it is capable of considerable further expansion. The yield of 12·1 bushels per acre in 1927–28 was somewhat higher than the average for the preceding ten years. The general yield is lower than in many of the other states,

probably owing to the rapid expansion of the industry. Oats (235,000 acres) is the only other cereal to which any considerable attention has been given.

Though the south-west has a suitable climate for vine- and

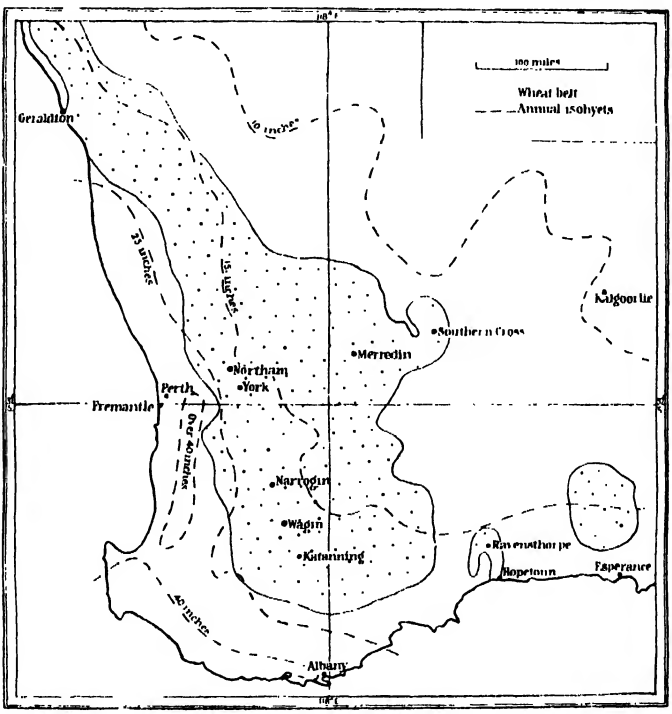

FIG. 112. WESTERN AUSTRALIA WHEAT BELT

The crop avoids the wetter coastal districts; note the extension into the mallee country.

fruit-farming, this aspect of husbandry has not yet reached the degree of development found in New South Wales, Victoria, and South Australia. Orchards cover about 19,000 acres, and are found on cleared hill-slopes in the south-west, especially near Perth, and in parts of the wheat belt; a large variety of fruits is grown, but the greatest attention has been given to apples for the export trade. Citrus fruits, particularly oranges, are chiefly grown near Perth and in the neigh-

bourhood of Northam. Vines cover about 5000 acres, principally found near Perth and Bunbury; wine-production has shown some expansion, but seems unlikely to become very important in the near future.

The northern and north-western coastal districts have considerable possibilities in connexion with tropical agriculture. It has been demonstrated that such fruits as bananas, pineapples, and even dates can be grown in some localities, and there are areas suitable to both rain and irrigation cotton. Without labour resources, however, development is impossible.

The number of men engaged in mining in 1928 was nearly 5000, of whom about four-fifths were gold-miners. Since 1903 the gold-production has steadily declined, but the value of the metal obtained in 1928 (£1,671,000) was some 85 per cent. of the Commonwealth production. There are nineteen proclaimed goldfields in the state; no new ones have been added since 1900, while within those already known there have recently been no important new finds. In the auriferous rocks in the western part of the plateau from Hopetoun to the Kimberley district considerable amounts of alluvial gold have been found, but the bulk is now obtained by reef-mining. Most fields now produce little; indeed, in 1928 75 per cent. of the output came from the small East Coolgardie field, centring on Boulder-Kalgoorlie and containing the famous "Golden Mile." Next in output was the Mount Margaret field (into which the railway penetrates to Laverton), with 9 per cent., followed by the Murchison, with 6 per cent. The railway to Meekatharra in this field has just been extended to Wiluna, in the East Murchison field, where large reserves of somewhat low-grade ore are now being developed; an important production is anticipated.

Other metal-mining is limited, not by lack of considerable resources, but by high production costs, so that the output is variable and largely dependent upon the market prices. Copper has been won chiefly in the Pilbara area, and tin principally from the Greenbushes field, in the extreme south-west. Lead is worked at Northampton, near Geraldton, and silver-lead ores are known in a number of northern districts.

The resources in iron ore are very large, but unworked, there being no suitable coking coal in the state; most noteworthy is the hæmatite of Yampi Sound, north of Derby, an enormous deposit, the working of which is receiving consideration.

Next to gold, coal is the most important mineral, and

FIG. 113. MUNDARING WEIR

Pre ling the water-supply of the Eastern Goldfields (Kalgoorlie area). Water is pu d up from this reservoir to a suitable height, and carried by gravity to the goldfields, serving townships *en route*.

By courtesy of the Immigratio Offic mmonwealth of Australia

there has been an increasing production (five collieries yielded 530,000 tons in 1928) from the Collie field, used principally on the railways and in the Perth electricity works. It is not of very good quality, and contains a high percentage of moisture, but is superior to that known to exist at other places, notably on the Irwin river and along the western coastal margins. Other known minerals include manganese, asbestos, gypsum, mica, and bauxite, while boring for oil

has been undertaken in the Fitzroy basin. It is noteworthy that the percentage of mineral exports in relation to total exports was 84·5 in 1903 and barely 6 in 1928.

Manufacturing is mainly connected with the treatment of primary products; in this respect Western Australia is the least important of the mainland states.

Towns and Communications. Mining is responsible for much railway development, and this has helped to serve agricultural and pastoral occupations in interior districts, thus promoting the general progress of the state. The railway-system comprises 4100 miles of state lines of 3 foot 6 inch gauge, in addition to which there are some 800 miles of private lines largely serving mineral and timber country, as well as 453 miles of the Federal standard-gauge trans-continental line running east from Kalgoorlie. A well-integrated system is developing in the more settled area, where the main line from Fremantle cuts through the heart of the agricultural area to the Eastern Goldfields and where there are more or less parallel north-to-south lines, one running from Flinders Bay roughly along the edge of the plateau to Geraldton and the other farther east, from Albany northward through Northam. Still farther east is a recently completed line running northward from Esperance. Geraldton is another important port terminal.

Perth itself is situated twelve miles up the drowned estuary of the Swan river, and is not reached by shipping. The metropolitan area includes a number of suburbs, such as the orchard and vine district of Guildford, eight miles to the east, and Midland Junction, two miles farther on, with important railway-workshops, as well as Fremantle (population, 32,000, included in the metropolitan total of 203,000), the ocean port, with an improved harbour giving 36 feet of water and concentrating the bulk of the trade of the state, notably in wool and wheat. In addition Fremantle is an important port of call for passenger and mail traffic. Its importance depends on its position in regard to routes *via* Suez and the Cape and upon the railways that give it an extensive hinterland. Its growing use will necessitate further accommodation for shipping. Fremantle is also expanding as

an industrial centre. Between Perth and Fremantle the Swan makes a remarkable expansion, known as Perth Water. The metropolitan area is without a rival in the western half of the continent, and it is of interest that the water-supply is dependent upon artesian bores, as well as upon reservoirs in the Darling Range, including that at Mundaring.

The main line to the Eastern Goldfields first passes through dairying and wine-growing land, to reach Northam (popu-

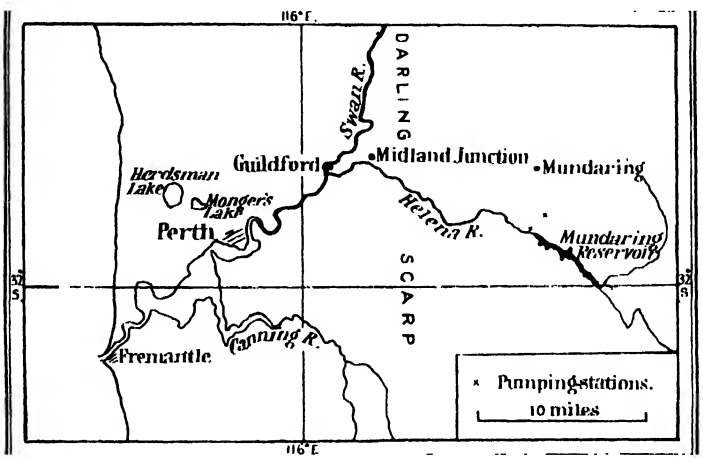

Fig. 114. Perth, Fremantle, and the Mundaring Reservoir

lation, 5000), the principal agricultural centre of the state, situated on the Avon, the chief tributary of the Swan, in a district important for wheat, fruit, and dairying. Northam's industries include flour-milling and brewing. The railway traverses the wheat-sheep belt to Merredin—a junction for several branch lines—and Southern Cross, the latter an old gold centre, in a district where wheat-growing is developing. Farther on is pastoral country into which wheat is penetrating, and beyond the derelict mining town of Coolgardie[1] Kalgoorlie (population, 5300) is reached, adjacent to which is Boulder (population, 5500), the principal gold-mining

[1] At the beginning of this century Coolgardie had a population of 16,000 and Kalgoorlie one of 30,000.

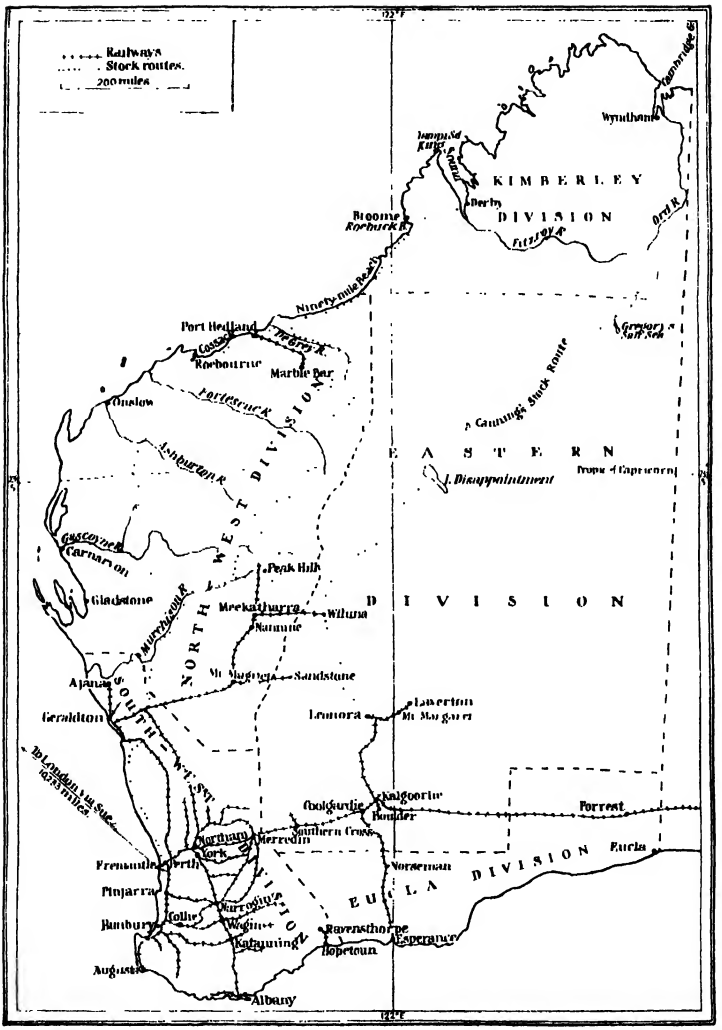

FIG. 115. WESTERN AUSTRALIA—RAILWAY DEVELOPMENT

centre. At Kalgoorlie, 380 miles from Perth, not only is connexion made with the Federal line, but there is a link northward to the now unimportant mining centres of Leonora and Laverton, both in thinly stocked pastoral country. Coolgardie is linked southward through Norseman with Esperance, between which places, in mallee country, wheat-growing is expanding.

From Perth a line runs southward along the rim of the Coastal Plain Artesian Basin, through the orchard country round Annandale and Pinjarra, to Bunbury. Bunbury (population, 5000) is the second port of the state; its railway running eastward through Katanning serves jarrah country, the coalfield of Collie (population, 3700), and apple, wheat, and wool areas, which indicates the varied character of its trade.

Albany (population, 4000) is on Princess Royal Harbour, an almost landlocked inlet of King George Sound, one of a number of openings along a sunken granite coastline. Its immediate hinterland is hilly—almost mountainous—well-watered country, and its relatively cool summer climate makes it an important resort. Jarrah and karri are exported, and dairying and fruit-growing are expanding in the district. The line northward passes through the timber and orchard country round Mount Barker, makes important connexions at Katanning, Wagin, and Narrogin (population, 3000), all centres of mixed farming, and goes through the old settlements of York (population, 1600), on the Avon, and Northam to the wheat and sheep lands that lie to the south-east of Geraldton.

Geraldton (population, 4700) is a rising port, with an improved harbour fed by several railways, particularly by those from the south and by that running inland to mining districts, which provide wheat, wool, and minerals for export. The immediate hinterland is excellent sheep country, and wheat-growing is rapidly increasing; flour-milling and a superphosphate factory are evidences of this development. The main line inland runs through Mount Magnet (with a branch to Sandstone), turns northward to Meekatharra (with a mineral railway to the gold and manganese area of Peak

Hill), then eastward to the gold centre of Wiluna. This line passes through country which carries little stock, but is served by stock routes from the northern savannas; sandalwood also comes from the hinterland.

The emptiness of the north-west is a matter of concern to the state Government, but development is very slow. Pastoral country with large sheep-stations is served by small ports such as Carnarvon, at the Gascoyne mouth, with a freezing works and local experiments in tropical agriculture; it is interested in pearling, as also is Onslow, at the Ashburton mouth. Sheep are the chief pastoral interest as far round as Cossack and Port Hedland, which has a short railway to the mineral centre of Marble Bar. Broome, on Roebuck Bay, is the principal centre of the pearling industry, and Derby, on King Sound, serves the extensive cattle-stations of the Fitzroy basin. Wyndham is the port for the cattle country of the Ord basin; a state meat-works operates here, and experimental tropical cultivation is carried on. It is of interest that a weekly air-mail service connects Perth with the coastal settlements of the north-west as far as Derby.

As showing the extension of wheat-growing it may be noted that the short railway in the south from Hopetoun to Ravensthorpe, originally serving a gold and tin area, has opened up good pastoral and agricultural country.

Trade. In 1927 28, excluding inter-state trade, the imports were valued at nearly £9,000,000 and the exports at nearly £16,250,000. The imports largely consisted of textiles and apparel, machinery and metal goods, motor-cars, and oil, but such items as tea, timber, tobacco, and coal were also prominent, while it is noteworthy that Western Australia is not self-supporting in dairy products. Inter-state trade includes large imports from the eastern states, notably of sugar, agricultural implements, woollen goods, and boots and shoes. Of the exports, wheat and flour led at £7,500,000, wool following at £3,900,000. The gold export was valued at about £1,300,000, timber at nearly £1,000,000, while fruit, hides and skins, sandalwood, and pearl shell all figured prominently.

TERRITORIES OF THE COMMONWEALTH

Of the territories directly controlled by the Commonwealth (see p. 119) only the Northern Territory and Norfolk Island will be dealt with in this section.

The Northern Territory

This is bounded on its landward sides by the lines 129° E., 138° E., and 26° S., leaving only a small proportion of the total area of 523,620 square miles south of the Tropic of Capricorn. The bulk of the small population consists of aboriginals, numbering about 21,000, of whom perhaps 10 per cent. find employment, chiefly on cattle-stations, the remainder being mainly beyond European influence. The suggestion has recently been made that Arnhem Land should be reserved for aboriginals, and be provided with cattle-stations for their use. Excluding these, there is a European population of about 3700 and about 800 others, largely Chinese. In recent years the non-aboriginal population has fluctuated round 4000, and is principally in northern districts; in 1888—when the railway to Pine Creek was constructed in connexion with gold-mining—it was 7500, more than half of these being Chinese. For administrative purposes the territory is divided along 20° S. into North Australia and Central Australia.

Structurally most of the area belongs to the Western Plateau, although the Great Artesian Basin appears in the south-east. Toward the south are the Macdonnell Ranges, where roughly west-to-east ridges of resistant quartzite cut by remarkable transverse gorges, the result of an earlier pluvial period, when the mass was gradually rising, stand out above the general level, reaching 4800 feet in Mount Heughlin. Elsewhere the plateau dips down, generally gradually, to the Artesian Basin on the one hand and the coastal plains on the other, though the flat Barkly Tableland reaching perhaps 1200 feet—is a feature of the country south of the Gulf of Carpentaria; the interior of Arnhem Land—not fully explored—probably reaches a similar level.

The coast is generally low and flat, but the unindented shore of the Gulf of Carpentaria contrasts with the drowned inlets and islands of Arnhem Land. The coastal rivers are numerous, and include the Victoria, Daly, Adelaide, Roper, and McArthur, all of which carry much water in summer. Elsewhere there are wadis, salt lakes,[1] and swamps, and the Finke occasionally carries flood-water southward from the Macdonnells.

Winter is a well-marked dry season, and more than a quarter of the area in the southern part of the Territory has an annual rainfall of less than 10 inches. The rainfall increases northward from Alice Springs (11 inches) to Daly Waters (26·5 inches) and Darwin (61·5 inches), but is everywhere of the summer type. The dry heat of the interior contrasts with the damp heat of the coast lands; Darwin ranges from 77° F. to 85·5° F., and the mean monthly relative humidity never falls below 51, and for three summer months exceeds 90, while at Alice Springs it never rises above 37. Alice Springs (1926 feet) ranges from 52·5° F. to 84° F., and ten degrees of frost are not unknown on winter nights. The climate of this region is bracing.

In the Northern Territory there is little real forest, although palm-groves and mangrove-swamps mark many parts of the coast, but there is considerable eucalypt growth in the wetter north, which gives place southward to savannas marked by a scattered growth of wattles, with mulga scrub and saltbush country in the south. The sandy south-west and the Arunta Desert of the south-east are too arid even for pastoral occupations. There is a remarkable flush of growth after rain in the southern areas, which, however, are bare and dusty during drought. In North Australia are considerable areas of poor pastoral country due to surface layers of laterite or travertine, but in a belt running from Camooweal, in Queensland, through Newcastle Waters to Hall's Creek, in Western Australia, are excellent black soils, upon which flourish Flinders and other rich grasses.

Crocodiles are plentiful in the northern districts, where mosquitoes abound, and in the interior large anthills often

[1] Lake Amadeus is normally a level sheet of salt.

vary the generally flat topography. In Central Australia dingoes and rabbits are great enemies of the pastoralist.

Development on a 'white Australia' basis may be said to have made little progress; there is only a negligible local supply of labour for plantation work, but enough has been done in coastal districts near Darwin and along the Katherine, Daly, and Roper rivers to show that coconuts, rice, tobacco, bananas, mangoes, cotton, and sisal can be successfully grown in places, though the staple crop is ground-nuts. Cattle and sheep were brought in the sixties to the Macdonnell Ranges, where the areas of good pasture are scanty and the rainfall very unreliable, and to the savanna districts somewhat later. Sheep, however, have never been important, though improved communications in Central Australia may lead to development in that area. The cattle industry has generally expanded since the Great War, but ticks have been a trouble in the northern districts, where the use of the dipping tank has become necessary. Cattle concentrate chiefly on the Barkly Tableland (where the Alexandra station is one of the largest in the continent), in the Roper, Daly, and Victoria basins, and in the Macdonnell area, where there are large but lightly stocked stations and where subartesian water is being increasingly tapped. Recent figures show the following distributions:

Division	Horses	Cattle	Sheep
North Australia .	20,800	676,500	350
Central Australia .	10,700	92,000	7,300

Live cattle are mainly sent away *via* stock routes for slaughter in adjacent territories, as a meat-packing enterprise at Darwin was not successful. Buffaloes introduced from the Malay region a century ago have been carelessly slaughtered in coastal districts for their hides. Darwin is the centre for a small pearling and trepang industry.

There is a fair amount of known mineral wealth, and probably much in the interior that is unknown; labour and

transport difficulties and fluctuating prices hinder development. Recent gold-production has been negligible; in 1928 tin was worked in various places to the value of £11,000, and a little mica came from near Alice Springs.

Darwin (population, 1400), which is the administrative centre of North Australia, has a splendid deep-water harbour, with a very large tidal range. Apart from one or two coasting services it is not regularly visited by shipping. The

FIG. 116. ALICE SPRINGS, CENTRAL AUSTRALIA
Now reached by railway from Port Augusta.
By courtesy of the Immigration Office, Commonwealth of Australia

railway runs inland to Pine Creek and Katherine, and on nearly to Daly Waters, serving pastoral country. It has long been proposed to complete a trans-continental line (roughly following the Overland Telegraph) by taking the railway across Central Australia to meet the line from Adelaide that now reaches Alice Springs. Other proposals are to link Daly Waters *via* Camooweal with the suggested new line in Western Queensland (see p. 207) and to provide a railway from the Barkly Tableland to a port near the Sir Edward Pellew Islands.

The bulk of the population, especially in Central Australia, lies along the Overland Telegraph, which is also a stock route. On it are Newcastle Waters and Alice Springs. The latter is the administrative centre for Central Australia, and lies a few

miles north of Heavitree Gap, the principal gorge of the Macdonnells, and upon which stock routes converge. Heavy costs of essentials like fencing make stock-rearing difficult, and water-supply and communications still present serious problems, but considerable optimism prevails about the pastoral future of this region.

The existing railway-lines, of 3 foot 6 inch gauge, have a total length within the territory of about 550 miles; they are uneconomic, and it remains to be seen how far they will promote pastoral and mineral production. Some increase in population has recently been shown, and the mica output, though still small, has notably advanced. The total oversea trade in 1927–28 was valued at about £60,000, exports consisting chiefly of live cattle (sent to Manila) and pearl shell.

Norfolk Island

This somewhat elevated island, 930 miles east-north-east of Sydney, is in 29° south latitude and 168° east longitude, and covers rather more than 13 square miles. It has had a varied history. Discovered by Captain Cook in 1774, it became for a short time a penal station in 1788, later became an important whaling-station, and was again used as a penal station, after which the descendants of the *Bounty* mutineers were removed to it from Pitcairn Island in 1856. The Federal Government took over the administration from New South Wales in 1913. It is cliff-bound except on the south-west, but possesses a fertile soil and a genial, equable climate, with a mean temperature of 68° F. and an annual rainfall of 55 inches. The population is about 900. Whaling has practically ceased, but fisheries might be developed. Fruit-growing for the Commonwealth and New Zealand markets is important; bananas, oranges, lemons, and passion fruit do well; a little coffee is also grown. Among domestic animals cattle are the most numerous. The island attracts a number of tourists. The cable from Vancouver *via* Fanning Island and Fiji bifurcates here for Auckland and Brisbane. Imports —chiefly manufactured goods from the Commonwealth—were valued in 1927–28 at £43,000 and exports at nearly £20,000.

CHAPTER VI

THE TRADE OF THE COMMONWEALTH

A LARGE volume of inter-state trade is carried on, for which no complete figures are available; there is, for example, a considerable movement of sugar from Queensland to other states, while manufactured goods from the south-east are to a substantial extent marketed in other parts. In considering the oversea trade of Australia it is necessary to remember that a particular year may not be typical, as exports consist mainly of primary products that are largely dependent upon climatic conditions of a notably variable character, besides being subject to fluctuating price levels. A serious fall in prices, which began to be felt toward the end of the financial year 1928–29, has recently affected to a marked degree all the typical exports—wool, wheat, and metals.[1] It has been thought desirable, therefore, while making possible a general comparison with immediately preceding years, to concentrate upon the figures for 1927–28, which are fairly representative of the period, though the value of wool exported was substantially higher and that of wheat lower than in preceding years. Imports fluctuate considerably in sympathy

[1] The following figures of wool and wheat exports illustrate the recent difficulties:

WOOL (GREASY AND SCOURED)

Year	*Bales*	*Value*
1927–28 . .	2,470,036	£66,095,901
1928–29 . .	2,643,885	£61,612,995
1929–30 . .	2,464,695	£36,588,523

WHEAT (INCLUDING FLOUR EXPRESSED IN TERMS OF BUSHELS OF WHEAT)

Year	*Bushels*	*Value*
1927–28 . .	67,502,000	£19,859,000
1928–29 . .	100,090,000	£26,334,000
1929–30 . .	56,029,000	£14,984,000

with primary production and financial conditions, while they are subject to a tariff schedule which provides a general tariff, an intermediate tariff, and a British preferential tariff. As this has an important bearing on the direction of trade it seems further desirable to analyse briefly the position of various customers and suppliers.

OVERSEA TRADE IN THOUSANDS OF POUNDS STERLING[1]

	1923-24	1924-25	1925-26	1926-27	1927-28
Total imports	140,618	157,143	151,038	164,717	147,945
Total exports	119,487	102,030	148,772	145,140	143,213
Total trade	260,105	319,173	300,410	309,857	291,158
Value per inhabitant	£45 4s. 9d.	£54 6s. 10d.	£50 2s. 8d.	£50 14s. 1d.	£46 14s.

The following table shows the oversea imports and exports by states for 1927-28:

STATE	IMPORTS	EXPORTS
	£	£
New South Wales	65,081,801	51,822,915
Victoria	47,911,131	31,728,558
Queensland	11,760,214	21,855,054
South Australia	12,509,300	18,030,143
Western Australia	9,011,294	16,252,679
Tasmania	1,640,817	3,434,456
Northern Territory	30,413	20,265

[1] For purposes of comparison, as showing the effect of the world depression upon total trade, the following figures are given for the two following years:

	1928-29	1929-30
Imports		
Merchandise	£143,281,449	£130,813,471
Bullion and specie	£366,432	£320,798
Exports		
Merchandise	£140,993,932	£97,100,000
Bullion and specie	£3,926,520	£27,748,540

The fall of the price level of primary products accelerated during the year 1929-30; hence the significant increase in bullion and specie exports.

In 1927-28 the figure given above for total imports included bullion and specie to the value of £1,008,430, while the total exports included bullion and specie to the value of £3,740,748.

It will be noticed that the exports are roughly proportionate to the population of the divisions.

The commodities imported are mainly manufactured goods. In 1927–28 textiles and yarns (largely cotton and silk goods) were valued at £19,700,000, apparel at £3,750,000, and bags and sacks at £3,600,000, while another aspect of Australia's present manufacturing deficiencies is illustrated by the import of electrical machinery, cable, and wire (£7,127,000), other machinery (£2,400,000), iron and steel, including pipes and tubes (£6,260,000), and cutlery and tools (£1,870,000). The development of motor-transport is shown by imports of motor-cars and parts (£8,257,000), oils, chiefly petroleum (£8,060,000), and rubber and rubber manufactures (£3,720,000). Among foodstuffs imported were tea (£3,500,000) and fish in tins (£1,140,000). Other items of importance were paper and paper manufactures (£6,000,000), drugs, chemicals, and fertilizers (£4,810,000), timber (£3,750,000), tobacco, manufactured and unmanufactured (£3,000,000), floor-coverings (£2,630,000), glass and glassware (£1,220,000), whisky (£1,104,000), while also of interest were musical instruments, crockery, and copra.

With regard to exports, wool (nearly half the total value) led at £66,100,000, about 10 per cent. higher than in the previous year, while wheat at £14,630,000 showed a decline of over £6,000,000, for which drought was largely responsible. Foodstuffs were prominent, and included flour (£5,230,000), butter (nearly £7,000,000), meats (£4,810,000), sugar (£3,970,000) —a very fluctuating export—and milk and cream (£1,190,000), while fresh and dried fruits (£3,420,000)—the former showing a great advance—and wine (£1,060,000) were also prominent. Apart from other products, the pastoral industry was represented by hides and skins (nearly £10,000,000) and tallow (£1,080,000), while the value of the leather export exceeded £500,000. The timber export, including a small proportion of sandalwood, was valued at £1,360,000. Of minerals there were exported lead (£3,516,000), concentrates of silver with lead and zinc (£1,700,000), zinc (£1,232,000), and decreasing values of coal (substantially declined), tin, and copper; gold was sent away to the value

of £2,800,000 and silver of nearly £1,000,000. The pearl-shell export was fairly steady at £338,000.

Direction of Trade. The percentages in 1927–28 of imports derived from and exports sent to the leading countries with which trade is carried on are shown in the following table:

Country	Percentage of Imports from	Percentage of Exports to
United Kingdom	42·65	37·90
United States of America	23·66	6·25
Dutch East Indies	3·86	1·36
India	3·76	1·81
Germany	3·12	8·40
Japan	2·89	8·78
France	2·62	10·59
New Zealand	2·23	2·69

The proportion necessarily fluctuates somewhat from year to year, but it is noteworthy that the share of the United Kingdom in the import trade has somewhat declined in recent years (it was 44·71 per cent. in 1923–24), while that of the United States has been substantially steady. The proportion of exports to the United Kingdom shows a fluctuating tendency; it is affected by various factors, including the growth of direct shipment to foreign countries. The United States is clearly a large seller and a relatively small buyer, being a producer herself of Australia's primary products, while among countries that are better customers than suppliers are Belgium, Italy, and Egypt. Germany is the principal country to have notably increased her trade in recent years.

An analysis of the imports in 1927–28 shows that the bulk of goods in the category of machines, machinery, and metal manufactures were imported from the United Kingdom, the United States and Germany chiefly sharing the remaining portion of this trade. Similarly, the United Kingdom had an overwhelming proportion of the import trade in apparel, yarns, and textiles, Germany having a share in the trade in apparel and textiles, and India and Japan sending a proportion of the cotton goods. India, however, sent the bulk of

the bags and sacks imported, while Japan sent the major portion of the silk and silk goods, though France and Switzerland had each a large share. The United States dominated in the sending of motor-cars and parts, as well as of oil, though of the latter commodity the Dutch East Indies was an important supplier. Timber came from a variety of countries, notably the United States, with smaller quantities from Sweden, New Zealand, Norway, Canada, and Japan. Paper and stationery were imported from the United Kingdom, Canada, the United States, Sweden, and Germany. Rubber and rubber goods came largely from British Malaya, but were also imported from the United Kingdom and the United States. Fish in tins was largely imported from Norway and Canada and tea from the Dutch East Indies, while phosphates and copra came from the Pacific islands.

The leading customer for wool was the United Kingdom; France, however, took more than half as much, while the big buyers, in descending order, were Japan, Germany, Belgium, the United States, Italy, and Russia, the last-named country taking an unusually large quantity in 1927-28. The wheat exported was sent mainly to the United Kingdom, although Italy, the Union of South Africa, Egypt, Japan, and Belgium took important quantities; Egypt was a large customer for flour. The bulk of the butter was sent to the United Kingdom, the Dutch East Indies taking, however, a fair amount. Hides and skins were sent largely to France, the United States, Germany, and the United Kingdom, the first-named country taking a notably large quantity of sheepskins. Dried fruit and wine were marketed mostly in the United Kingdom, which, with Germany, took most of the fresh fruit. Sugar was notably sent to the United Kingdom and New Zealand, while timber went largely to the latter country and to the Union of South Africa. A feature of interest was the marketing of a good deal of milk and cream in Japan and Malaya. Of metal exports, the United States and India took most of the gold, the latter country also receiving much silver. Zinc and zinc concentrates went mainly to the United Kingdom, Belgium,

and Germany, the last two countries also taking most of the lead. A good deal of the coal exported went to New Zealand. It is noteworthy that Australia acts as an intermediary for part of the import and export trade of that country.[1]

Ports. The following table places the chief ports of the Commonwealth in order on the basis of the value of their oversea trade in 1927–28 (for shipping tonnages see p. 136):

Port	Imports	Exports	Total
	£	£	£
Sydney	63,048,609	50,449,821	113,498,430
Melbourne	47,090,110	28,720,490	75,810,600
Brisbane	10,279,647	15,827,062	26,106,709
Port Adelaide	10,220,944	12,857,944	23,078,204
Fremantle	8,692,103	12,159,807	20,851,910
Port Pirie	2,229,807	2,496,198	4,726,005
Hobart	929,290	2,613,410	3,542,700
Newcastle	1,921,158	1,303,958	3,225,916
Townsville	627,978	2,187,625	2,815,603
Geelong	680,642	1,260,758	1,941,400
Bunbury	36,903	1,850,144	1,887,047
Wallaroo	59,233	1,579,886	1,639,119
Launceston	666,008	658,011	1,324,019

It will be noted that the largest ports dominate in the import trade, but that the minor ports chiefly serve their hinterlands in the export trade.

[1] Efforts are now being made to obtain comprehensive figures for the inter-state trade. The first statistical tables dealing with this appear in the latest number of the *Official Year book of the Commonwealth of Australia* (No. 23, 1930); the tables, however, are incomplete, and do not cover, for example, sugar and manufactured goods.

CHAPTER VII

AUSTRALIA: CONCLUSION

It is frequently pointed out that Australia has an area similar to that of the United States of America, and it is sometimes suggested that the development of the latter represents a standard that the former may achieve. Such comparisons from the geographical point of view are idle. Widely differing physical conditions—differences of world position, of latitude, of relief distribution, and of consequential climatic features, together with varying mineral resources, particularly in coal and oil— provide one set of contrasted conditions. Another group of contrasts is to be found in the longer history and development of the United States, in the different racial elements that contribute to its much larger population, as well as in the mental outlook that each has developed. The history of Australia is short, but it is the story of the growth of a nation developing individual characteristics and confronted with problems that differ in degree, if not always in nature, from those of other continents outside the Old World.

Federation into a Commonwealth –although the working of the Constitution is the subject of severe criticism –could not have been achieved without a general realization of a community of interests that must provide the basis of a national consciousness.[1] Among the subjects upon which there is a definitely Australian opinion are the maintenance of the population broadly upon the present basis, the maintenance of a high and advancing standard of life, and the development

[1] The Federal system is criticized from two points of view. On the one hand it is suggested that certain states would fare better if they were to become completely autonomous once more. From another angle the basis of the federation is criticized as leaving too large powers to the individual states, so that there is divided authority on important matters.

as far as possible of a self-sufficing continent. The comparatively haphazard and empirical expansion of the older pioneering days has been replaced by a conscious policy of development and organization, in the pursuit of which the resources of science and Government are being increasingly used.

It is not easy to estimate what might be the effect of the withdrawal of the existing restrictions on coloured immigration. Would such removal, for example, lead to any rapid

FIG. 117. BULLOCK TRANSPORT IN THE NORTHERN TERRITORY
By courtesy of the Immigration Office, Commonwealth of Australia

development of the tropical north? A good deal more detailed knowledge and research will be necessary before a very exact answer can be given to the question, but it seems doubtful whether the conditions of soil and climate in the northern areas favour any considerable development of tropical plantations, however adequate might be the supply of labour. The interior of Arnhem Land, for example, is still but little known, and the most that has been demonstrated so far is that restricted areas of the coastal belt and of river-valleys are capable of producing certain tropical crops. The only Asiatics who voluntarily entered these northern areas in any considerable numbers were Chinese; these were attracted by mining. 'White Australia' would

probably have more to fear in the immediate future from the entry of such people into the settled areas of the south-east, where industry is developing.

Nevertheless, opinion is concerned about the emptiness of the north, but as it will not tolerate development even with the use of indentured coloured labour, the problem of white settlement there will have to be faced. It is realized that development will involve great expenditure, notably on rail and other communications. Strategic considerations lead to interest from another point of view. Darwin has been suggested as a naval station, while aerial development lends added importance to this part, which lies nearest to Asia, and so to the air-route to and from Europe.

The increasing expansion of sugar-growing northward along the east coast has been marked by the entry of South Europeans, notably Italians, some 7000 of whom are stated to be engaged in it. This has been regarded as suggesting a menace to the Australian standard of life differing in degree, but not in kind, from that which would arise from Asiatic immigration. This criticism is based partly on sentiment arising from the almost entirely British character of the Australian population and partly on the desire to maintain the standard of living that has been built up and which has regard to the amenities available in a modern civilized state.[1]

This desire to maintain a high standard of comfort is shown by much legislation involving minimum rates of wages and conditions of work and far-reaching social services. In the pursuit of economic prosperity education has not been neglected, and primary education in the more scantily populated districts—an obviously difficult problem—is secured by the establishment of many small schools, as well as of central schools, and, when the population is very scattered, by itinerant teachers and by correspondence, the latter being a method that has proved very effective. Each capital city has its university, the oldest being that of Sydney, which

[1] Economic difficulties have recently led to further restrictions upon non-British Europeans, while immigration from Britain has also been slowed down.

dates from 1850, and which was soon followed by that of Melbourne.

Scientific exploitation of the natural resources of the continent is rapidly displacing the more or less haphazard methods of earlier times. Active state Departments of Agriculture and the work of research stations, as well as private effort, are leading to a rising standard of agricultural

FIG. 118. A BUSH SALESMAN

Note the almost vertical sun.

By courtesy of the Development and Migration Commission, Commonwealth of Australia

production. The remarkable expansion of wheat-growing has been made possible by growing the crop in a rotation, by the use of dry-farming methods and of large implements adapted to the local conditions, by growing varieties which research has shown to be suitable, and by the use of manure. The soils of the wheat belt are generally red and lacking in humus; there is a notable deficiency of phosphates, and one of the most striking developments in recent years has been the great increase in the use of superphosphates, the supply of which comes almost entirely from local factories. The production of crops like sugar, rice, and cotton with white

labour under highly protective conditions will inevitably lead to efforts aiming at a more economic basis of production.

In spite of the light and uncertain rainfall of many areas the problem of water-supply and water-conservation has received great attention, and as a result many areas are carrying stock or being intensively cultivated without the

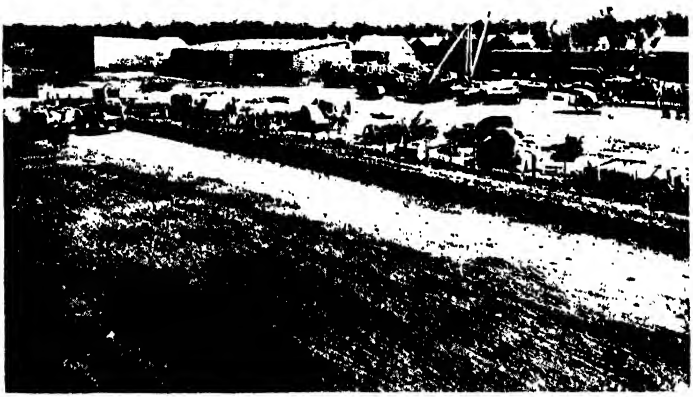

FIG. 110. A COUNTRY RAILWAY-STATION

Note the wide cattle road, a common feature in Australia, and the evidence of wheat-farming.

By courtesy of the Immigration Office, Commonwealth of Australia

risks of failure that formerly existed. The waste of water from artesian wells, like the waste of natural forests, is being stayed, and the facilities for irrigation are expanding. The state and the Federal Governments are taking advantage of the resources of modern science and engineering to develop primary production, and while a good deal of the continent will always remain useless for either pastoral or agricultural activity, drought has been robbed of much of its former dread. It is possible to over-emphasize the serious effects of drought; when its measure has been taken over-stocking can be avoided; it will always lead from year to year to

variations in production, but it must be remembered that bright sunshine is one of Australia's greatest assets.

The decline in mining, more particularly in gold-mining, has necessarily been a matter for serious concern. There is no reason to suppose that the mineral resources of the continent are exhausted, but in many cases accessible mineral wealth has been worked out or worked so long as it has been remunerative. High production costs—labour, machinery, and transport—and the varying price level are important factors in limiting the exploitation of minerals, but that these considerations are not necessarily retarding development is shown by the enterprise now going forward in the Mount Isa silver-lead area of Queensland and in the Wiluna goldfield of Western Australia. New, rich discoveries are always possible in the at present little-known areas of the continent. The decline of mining has been a contributory cause of the drift of population to the towns.

Nothing is more characteristic of Australian psychology than the determination to develop secondary industries with a view to becoming as far as possible independent of oversea sources of supply of manufactured goods. Remoteness from the great manufacturing areas of the world and a spirit of independence both contribute to this, and the most recent development of tariff policy has been deliberately to sacrifice the revenue yield of the tariff with a view to encouraging an expansion of local manufacturing industry. The criticism to which this policy is subject is a reflection of the unequal industrial development in the several states. The effect, however, is seen in an expanding population being maintained with a declining proportion of primary producers, as well as in the concentration of population in the metropolitan areas, which are the principal manufacturing centres.

These developments of national character and policy have been marked by crises of an industrial and financial character to which world conditions and drought have alike contributed. Costs of production in secondary industries are relatively high, largely because of the maintenance of a standard of life that is one of the highest in the world, a reduction in which Australian opinion will hardly contemplate. More-

over, the financial commitments in respect of railway development and of large-scale irrigation enterprises[1] have been subject to criticism, and it has been suggested that Australia has perhaps been over-reaching herself in paying so much attention to undertakings that are only remotely productive instead of aiming at developing more intensively the areas that are already relatively well settled without these artificial aids. Even Canberra has been described as a 'white elephant.'

From this point of view Australia is perhaps in an experimental stage, and has still to strike a proper balance between primary and secondary production, while maintaining her position as a modern, highly organized state built up upon a white and essentially British basis, with a high level of civilized life. Presenting many features that are unique among the continents of the world, without present complications arising from differences of race or general outlook, Australia is confronted with the outstanding problem of empty spaces in a competitive world large areas of which are overflowing with people. To accelerate her present individual development is the aim of Australian statesmanship.[2]

[1] The *New South Wales Year-book* for 1928–29 says of the Murrumbidgee irrigation area: "The irrigation settlement is as yet only partly developed, and may be regarded more as an investment than as a productive undertaking."

[2] See *The Prosperity of Australia: an Economic Survey*, by F. C. Benham (1928), *Australia*, by W. K. Hancock (1930), and *The Economic History of Australia*, by E. Shann (1930).

CHAPTER VIII

THE DOMINION OF NEW ZEALAND

LYING east of the Tasman Sea, in latitudes roughly corresponding to those of Victoria and Tasmania, and with Wellington some 1240 nautical miles east-south-east from Sydney, New Zealand is the considerable land area nearest to the Antipodes of Britain, an isolated oceanic position in the Southern Hemisphere responsible for her late discovery. New Zealand stands on an elevated part of a submarine ridge that may be traced running south-south-east from New Guinea and which sends a branch northward from New Zealand to the Fiji and Tonga Islands. On the expansion of the ridge in the neighbourhood of the main islands lie various small groups—Three Kings, Chatham, Bounty, Antipodes, Snares, Auckland, and Campbell—while farther north are the Kermadec and Tokelau or Union groups, Niue, the Cook group, and other small islands in the same part of the Pacific, all of which come under the jurisdiction of the Dominion. In addition, New Zealand holds the League of Nations mandate for Western Samoa and shares that for the island of Nauru, and since 1923 has been responsible for the administration of the Ross Sea Dependency, lying due south, in the Antarctic.

The Dominion proper includes North Island, South Island, Stewart Island, and the Chatham Islands, and covers an area of 103,285 square miles. Of this total North Island claims 44,131 square miles, South Island 58,120 square miles, Stewart Island 662 square miles, and the Chatham Islands 372 square miles. Cook Strait, with a minimum width of sixteen miles, separates the two main islands, and Foveaux Strait cuts off Stewart Island from South Island. The main islands have a general trend from south-west to north-east; North Cape lies in latitude 34° 20′ S. and South Cape in

latitude 47° 20′ S., West Cape and East Cape being respectively in longitude 166° 30′ E. and 178° 30′ E. Time is kept eleven and a half hours in advance of Greenwich. Latitude 40° S. cuts off the southern peninsula of North Island, so that the eastward-moving cyclones of the forties of latitude will be an important climatic influence, as also will be that of the ocean as affecting a comparatively small area no part of which is far from the coast.

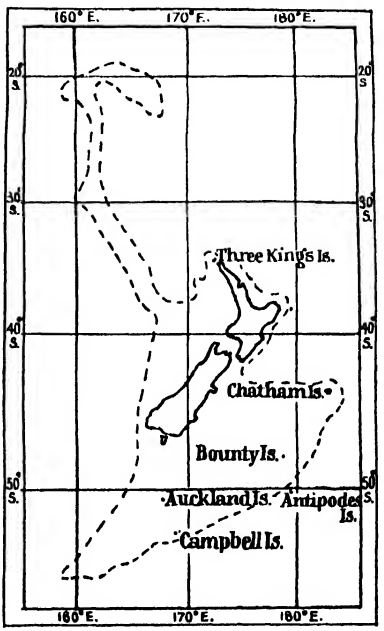

FIG. 120. PROBABLE AREA OF THE NEW ZEALAND CONTINENT IN THE PLEISTOCENE PERIOD

GENERAL PHYSICAL CONDITIONS

Structure and Relief. As may be expected from its isolated position on a submarine ridge, New Zealand has had a varied geological history. Structurally it presents some features of a continental character; it contains residual as well as young fold-mountains, while relatively recent transgressions of the sea are indicated by the extensive development of Cretaceous and Tertiary rocks, notably in North Island. Fossil evidence suggests that isolation from Australia came in mid-Tertiary times, and was preceded by severance from Malaya in the Later Cretaceous period. Since that time mountain-building and vulcanism have been prominent; the latter is now apparently dying out.

Almost all periods of sedimentation are represented in the geology of New Zealand, though there appears to be doubt about the presence of rocks of pre-Cambrian age. The oldest

rocks—gneiss, schist, and others of igneous origin—crop out mostly in the fiord region of the south-west, while the core of Stewart Island is of gneiss. The dissected plateau of the south of South Island consists of Primary rocks, which also provide the backbone of the Southern Alps and the projections divided by Tasman Bay; these rocks largely consist

FIG. 121. A DAIRY FARM ON THE KAIKOURA COAST
The Seaward Kaikouras, capped by clouds, are the background.
By courtesy of the High Commissioner for New Zealand

of greywackes, shales, and slates. Elsewhere Primary rocks are but little in evidence. The Southern Alps are flanked in the east by rocks of Triassic and Jurassic age, which may be traced north-eastward in the Tararua, Ruahine, Kaimanawa, and Raukumara Ranges of the North Island. Elsewhere, apart from plains of recent fluviatile origin and the large areas of volcanics notably found in North Island, the rocks are of Cretaceous and Tertiary age, and include limestone, sandstone, and coal.

FIG. 122. NEW ZEALAND—PHYSICAL.

Note the plateau of North Island and the position of the 'cold lakes' of South Island.

The dissected peneplain of the south, often referred to as the Otago peneplain, extends as far north as Lakes Wamaka and Hawea; it tilts southward, and Stewart Island is an isolated portion of it. It is a remnant of an old mountain system, part of a land-mass once extending far to the west and possibly part of ancient Gondwanaland. Its 'grain' runs roughly from north-west to south-east, and it is significant that this direction is paralleled in the Auckland peninsula, which, although it has suffered more recent submergence, is essentially part of the old land-mass. The young fold-mountains stretch from the neighbourhood of Mount Aspiring (9975 feet) in a north-easterly direction, dividing northward toward Cape Farewell and Cook Strait. The latter branch is formed by the Kaikoura Ranges, in a longitudinal valley of which the Clarence river has cut a deep gorge. The Southern Alps, with sixteen peaks exceeding 10,000 feet, attain a maximum elevation of 12,349 feet in Mount Cook; they lie much nearer the west coast than the east, and their impressive character is deservedly reflected in their name. The Kaikouras, while not quite so high, are yet of considerable elevation. Tapuaenuku reaches 9460 feet.

FIG. 123. NEW ZEALAND — NORTH ISLAND GEOLOGY

In North Island the young fold-mountains are continued from Cook Strait toward East Cape. The ranges are highest in the western part of this belt, where Makorako, in the Kaimanawa Range, reaches 5700 feet. There is a well-marked valley from Cook Strait east of Wellington to Napier. Between the Ruahine Range and Mount Egmont the folding

is much more gentle, and the region forms a somewhat elevated belt, considerably dissected by gorges and valleys. The Kaimanawa Range is flanked on the north and northwest by a volcanic plateau largely covered with lava, pumice, and volcanic ash. In the southern angle of this volcanic area, which extends northward to the Great Barrier Island, and includes the hinterland of the Bay of Plenty, lie Ruapehu

FIG. 124. MOUNT EGMONT
Note the forest cleared for dairying.
By courtesy of the High Commissioner for New Zealand

(9175 feet), a cone which is intermittently active, and Ngauruhoe (7515 feet), which emits vapour and steam, as well as the dormant Tongariro (6458 feet). Round and north of Lake Taupo (the largest of many lakes occupying depressions in the volcanic plateau) is a thermal springs area covering 5000 square miles, with numerous geysers, mud volcanoes, and hot springs. The principal present activity is associated with a remarkable fault zone that extends from Ruapehu to White Island, an active cone in the Bay of Plenty. Many other fault lines have been traced in New

Zealand, and the almost perfect extinct cone of Mount Egmont (8260 feet) is associated with the fault lines that mark the coast of that westerly projection of North Island, while the lavas of the Otago Peninsula (by Dunedin) and the basalt of Banks Peninsula, both in South Island, were doubtless associated with the sinking of land formerly lying to the east. The only remnant of active vulcanism in South Island is to be found in the hot pools of the Hanmer Plains.

FIG. 125. NEW ZEALAND—SOUTH ISLAND—GEOLOGY

Earthquakes affect the whole of the Dominion, some of the most severe originating in the neighbourhood of Cook Strait. Many shocks have a shallow origin, and some are associated with eruptive activity; others have a more deep-seated origin, and it is of interest that several severe earthquakes have been associated with the edge of the submarine plateau lying some two hundred miles east of North Island, where the plateau sinks steeply to great depths.

The plains of New Zealand occur in scattered areas, and are largely of fluviatile origin. Such are the plains of Southland and Canterbury, as well as the narrower plain of Westland, in South Island. Other areas of recent deposits lie in the hinterland of the Hauraki Gulf, notably round the Thames and Waikato rivers and in the Wairarapa Plains, running in a strip north-east from Cook Strait and continuing to Hawke Bay. The plains of Wanganui, in North Island, are somewhat elevated, except along the coast, and largely consist of marine deposits, as do the Waimea Plains of the Nelson district of South Island. The alluvial Canterbury

Plains are the most extensive, and link the Banks Peninsula to the mainland.

Coasts. New Zealand, owing to its shape, has a long coast-line, with a total length of over 4300 miles. The detail has been largely determined by subsidence, but has been modified considerably, especially on the western side, by land-waste distributed by strong currents. This is well illustrated by the opposite coasts of the north-western projection of North Island, where the western side has its inlets blocked and its coast straightened by sand-bars and sand-banks, while the drowned valleys of the eastern side are entered without difficulty. For this reason, although Auckland, on a narrow isthmus, is in a position to take advantage of two inlets—Waitemata Harbour and Manukau Harbour—shipping concentrates on the former, which is on the eastern side. Elsewhere on North Island are few good natural harbours, the outstanding exception being Port Nicholson, upon which Wellington is situated. In South Island are two groups of sounds, one formed by the drowning of longitudinal valleys in the neighbourhood of Picton, by Cook Strait, the other consisting of the "Fifteen Sounds"

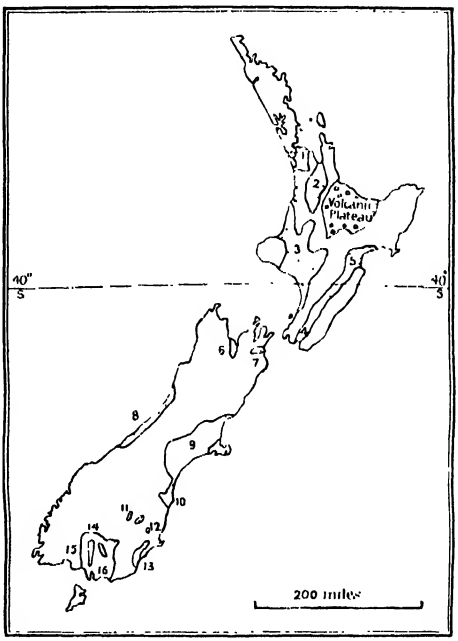

FIG. 126. NEW ZEALAND PLAINS

(1) Lower Waikato; (2) Middle Waikato and Thames; (3) Wanganui; (4) Wairapapa; (5) Hawke Bay; (6) Waimea; (7) Wairau; (8) Westland; (9) Canterbury; (10) Waimate; (11) Ida valley; (12) Taieri; (13) Tokomairiro; (14) Waimea; (15) Waiau; (16) Southland.

which mark the fiord coast of the south-west—magnificent gulfs, with towering mountains forming an unproductive hinterland. The best known of these—Milford Sound—is a typical fiord, with a relatively shallow entrance and a depth of nearly 1300 feet inside. Elsewhere in South Island the best natural harbours are connected with the Banks and Otago Peninsulas and in Stewart Island; both the Canter-

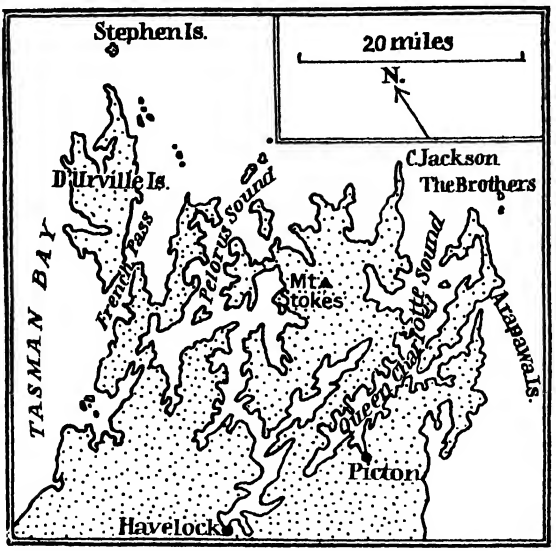

FIG. 127. THE SOUNDS OF MARLBOROUGH, BY COOK STRAIT

A sunken coast.

bury and Westland Plains have unindented coasts, and the long sandspit projecting from Cape Farewell has been formed by northward-sweeping currents.

Drainage. The topography is diversified by numerous rivers, most of which, owing to the varied relief and to the narrow shape of the islands, have no great length, and are frequently marked by falls, gorges, and deeply cut valleys. The considerable and well-distributed rainfall gives them a relatively uniform *régime* and a substantial discharge of water; they are, however, generally of a torrential character

and liable to sudden floods. They have little navigable value, but they provide possibilities which are being increasingly utilized for developing hydro-electric power. Noteworthy in North Island is the Waikato (220 miles long), receiving drainage from the western slopes of the Kaimanawa Range and from the southern part of the volcanic plateau and draining Lake Taupo; the lower course of the river, apart from that of its left-bank tributary the Waipa, provides steamers with seventy miles of waterway, but the mouth is obstructed by a sand-bar. The northern Wairoa, flowing into the bar-obstructed Kaipara Harbour, has some utility, and the Wanganui (140 miles long), though marked by rapids at low water, affords communication in somewhat difficult country. Also with bars, but of some navigability, are the Piako and the Thames (Waihou), flowing into the Firth of Thames. The Manawatu, which discharges a very large volume of water, is of interest because it has cut transversely through the fold-ranges between the Ruahine and Tararua Ranges east of Palmerston North. The Bay of Plenty and Hawke Bay both receive various rivers; of these the southern Wairoa, running into the latter, drains Waikare Moana.

In South Island the rivers are notable for the large quantities of shingle they have brought and still bring down. In the central region many rivers take their rise in glaciers, causing flooding in the spring and summer. Their valleys among the mountains are typically V-shaped, and characteristically much broader on the eastern than on the western side. The rivers running west from the Southern Alps are inevitably short, but farther north and beyond the region of glaciers are two noteworthy rivers, the Grey and the Buller, the latter having a length exceeding 100 miles. In the north-east of the island are several rivers walled in by steep mountains; they include the Clarence, running between the Kaikoura Ranges, and the Wairau, usable by small steamers up to Blenheim. The Canterbury Plains are composed of thick sheets of shingle, through which rivers flanked by old terraces run from the Southern Alps, frequently draining lakes on the eastern flank. Of these the Waimakariri gives access to Arthur's Pass from the northern end

of the plains, and the Waitaki, draining several lakes, including Lake Tekapo, and glacier-fed, cuts across shingle plains at the southern end. Rivers of the south include the Waiau, which drains lakes Te Anau and Manapouri, and the Clutha. The latter river, 210 miles long, discharges more water than any other in the Dominion, owing to the fact that its headstreams, which rise in the neighbourhood of the Haast Pass, north-east of Mount Aspiring, flow through Lakes Wamaka and Hawea, while later it receives the Kawarau from Lake Wakatipu, a great reservoir of water derived from snow-clad mountains. Gorges, open valleys, and river-flats mark its course, its mouth has a dangerous bar, and its navigability is slight.

The lakes of North Island are due to volcanic agencies—warping and subsidence, the distribution of erupted material, or to the occurrence of craters. Lake Taupo, 238 square miles in area and 534 feet deep, may be due to subsidence or to a great explosion. On the west it is bounded by cliffs of volcanic rock, on the east by pumice cliffs, and on the south by alluvial flats, while hot springs occur within the lake itself. Shortly after leaving the lake the Waikato jumps over the Huka Falls. North-east of Lake Taupo is the famous Thermal Region, with a number of lakes. Of these the largest is Rotorua (32 square miles), while Lake Tarawera lies west of the volcano of the same name, which erupted with disastrous results in 1886. Waikare Moana (21 square miles, 846 feet deep) is the deepest and most beautiful lake of North Island.

The lakes of South Island are mainly the result of glacial action. There are many small lakes occupying rock-basins at considerable elevations, but the large ribbon lakes occupy moraine-dammed valleys, while there is plentiful evidence of the earlier existence of similar lakes on rivers which do not now possess them—lakes filled with sediment or drained by the lowering of the barrier. All the large lakes of this class drain away from the Tasman Sea; the largest is Te Anau (132 square miles, 906 feet deep), but the deepest is Manapouri (56 square miles, 1458 feet deep); these two, with Wakatipu, the longest (52 miles long, 112 square miles in

area, and 1242 feet deep), provide the most impressive scenic interest.

Climate. The climate of the Dominion is not difficult to understand from consideration of its latitudes, its oceanic position, far from any great land-mass, and its distribution of relief. The dominating oceanic influence is reflected in an absence of extremes and in a summer mildness which strongly contrasts with the summer heat of a country like Italy, in comparable latitudes. The rainfall both in amount and in distribution shows distinct similarities to that of the British Isles, although New Zealand is on the whole a sunnier land, with a substantially greater annual total of bright sunshine, notably in the eastern parts.

Ignoring the effect of relief, it is found that there are no great temperature differences between north and south, although there is a difference of nearly 13° of latitude. Thus Auckland ranges from 51·5° F. to 67° F. and Invercargill from 41·5° F. to 57° F. The former shows a mild winter and a very warm summer, the latter a cool winter and a warm summer, with figures not strikingly different from those of Southern England. It is clear that at sea-level no part of New Zealand experiences either excessive heat or serious cold, and winter temperatures are broadly such as permit the growth of vegetation all the year round. The temperature differences between east and west are comparatively slight, but in interior districts and in sheltered valleys, notably in Otago and Southland, somewhat greater annual ranges may be expected, especially where the influence of relief is involved. Three stations on South Island may illustrate this. Hokitika, on the west coast, ranges from 45° F. to 60·5° F., Christchurch, on the eastern side, from 43° F. to 61·5° F., while Queenstown, on Lake Wakatipu, in the lee of the Southern Alps and at an elevation of about 1100 feet, ranges from 37·5° F. to 60° F.

Frosts seldom affect the coastal districts of North Island, but they are common in most parts of South Island, even well into the spring.

Being partly in the thirties and partly in the forties of latitude, the Dominion is affected so far as the part in the

thirties is concerned by the swing of the wind belts, and the remainder is subject all the year round to the depressions associated with the west wind belt. Actually the latter influence prevails south of 39° S., and it is only north of this that winds which may be called the south-east trades occur during the summer. In winter both islands are in the belt of the prevailing westerly winds. The effect, however, upon the seasonal distribution of rain is not important, for North Island has no dry season such as is associated with the 'Mediterranean' latitudes in which it is situated. Auckland, in this region, has more than 40 per cent. of its rain during the summer six months of November to April. In general the rainfall of the whole Dominion is well distributed throughout the year, and such seasonal differences as occur are slight.

Far more important in its influence upon rainfall is the effect of the relief distribution. In North Island the mean annual rainfall corresponds reasonably well with the relief; the heavier rainfall of Mount Egmont, of the district with high volcanic peaks, and of the mountain ranges of the east stands out; the lowlands round Wanganui and the coastal belt from Napier to Cook Strait have least, the latter being largely sheltered by the Tararua and Ruahine Ranges from the winds from the west. Only on Mount Egmont does the annual rainfall exceed 100 inches; over considerably more than half the island the amount exceeds 50 inches, while only in the driest areas referred to above does it fall below 40 inches.

South Island shows more striking differences. The whole western coast from Cape Farewell to South-west Cape has an annual rainfall exceeding 70 inches, while from a little north of Hokitika to beyond West Cape the amount exceeds 100 inches. Hokitika's total is 117 inches, but on the wettest part of the western flank of the Southern Alps—probably between 5000 feet and 6000 feet—200 and even 300 inches are doubtless experienced. The influence of high relief athwart the prevailing moist winds from the Tasman Sea is clearly the explanation of this, and the economic effect of the shelter thus provided to the eastern side is profound.

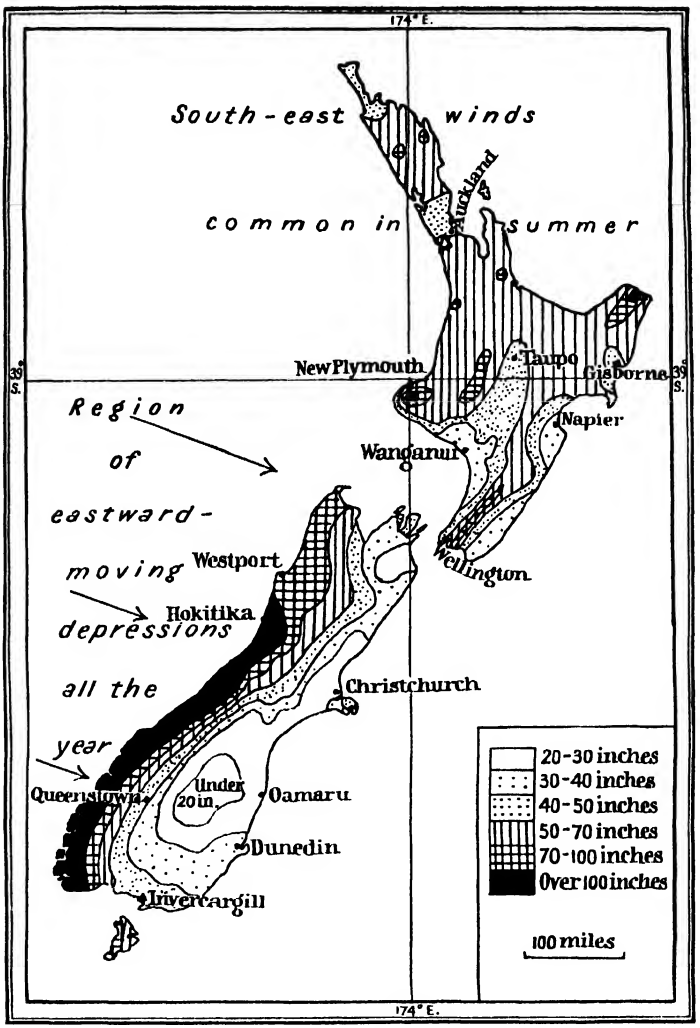

FIG. 128. NEW ZEALAND— MEAN ANNUAL RAINFALL

The falling off in the amount of rain is very rapid east of the divide, and the precipitation on the east coast is only moderate in amount, although the Banks Peninsula stands out with rather more rainfall than the plain. Typical rainfall figures are those of Nelson (38 inches), Christchurch (25·5 inches), Dunedin (37 inches), and Invercargill (46 inches);

FIG. 120. FRANZ JOSEF GLACIER, FROM LAKE MAPOURIKA

Lake Mapourika is a small lake in Westland, on the western flank of the Southern Alps.

By courtesy of the High Commissioner for New Zealand

the somewhat high figure for Invercargill is due to the convergence of winds in the Foveaux Strait. In sheltered valleys, notably in Central Otago, the rainfall declines to amounts that may almost be called scanty. Clyde, on the Clutha, the driest station in the Dominion, has a total of only 14 inches.

Snow occasionally falls on the open lowlands, but it never lies for a lengthy period; on the highlands of both islands it is necessarily common, and on the Southern Alps especially a large proportion of the precipitation is in the form of snow.

The snowline on the western side of the New Zealand Alps is about 3700 feet and on the eastern side about 3000 feet. Ice accumulates on an extensive scale, notably in the Mount Cook area, and the greater precipitation on the western side is illustrated by the Franz Josef Glacier, one of those flowing west, which reaches down to 700 feet above sea-level, while the Tasman Glacier, an eastern one, comes down only to 2500 feet. The only permanent ice on North Island is found in some small glaciers on the crater of Mount Ruapehu.

Reference must be made to the *Föhn* effect chiefly noteworthy on the Canterbury Plains, at the eastern foot of the Southern Alps. Descending air, robbed of its moisture and warmed both by the liberation of latent heat and by compression, results in a hot, dry, and gusty wind, very enervating while it is experienced. To a lesser degree a *Föhn* effect is felt in Otago and as far north as Hawke Bay.

Wind is rather characteristic of the New Zealand climate, and Wellington is famous in this regard, as the configuration of the islands leads to a concentration of wind on Cook Strait. The provision of wind-breaks in pastoral country has therefore considerable importance.

Natural Vegetation and Animal Life. Apart from areas which as a result of elevation are barren, New Zealand contains no land that can be described as desert. At the time of its discovery the Dominion possessed a varied and often beautiful flora, roughly equally divided between forest and grassland, the latter being found mainly in eastern parts. Long isolation is responsible for some three-quarters of the indigenous plants being unknown elsewhere in the world, and it is specially noteworthy that the near-by continent of Australia has contributed none of its characteristic flora. The plant life seems to have been derived mainly from an earlier connexion with the Malay region, but there are also affinities with the vegetation of Antarctic islands and of South America.

The forests have been so reduced by clearing and fires that only about 19 per cent. of the land is now in this category. The larger trees are mainly pines (conifers, but unrelated to European species), of which the kauri, only found north of

39° S., is famous—a huge tree yielding fine timber, but decimated by wasteful exploitation. Red and white pines—the latter largely used for butter-boxes—clothe the western slopes of the southern mountains, while extensive forests of small-leaved beeches (often miscalled birches) are found on the eastern slopes. Lianas, tree-ferns, and a carpet of moss often add to the beauty of the wetter forests, while it is of

FIG. 130. STORE CATTLE
Note the tussock grass.
By courtesy of the High Commissioner for New Zealand

interest that mangroves are found in some of the northern estuaries—very curious outside the tropics. Many of New Zealand's most beautiful flowers belong to the Alpine flora of the mountains, which extends up to about 7000 feet.

The open lands are characterized by grass of little value for pasture, much of it being of a coarse tussock type, so that extensive planting of European grasses has taken place, though the latter will not grow in stony soil or in exposed mountain areas. The principal open grassland areas before modern forest-clearance were the Canterbury and Southland Plains and the interior of Otago. Considerable

areas, notably the poor-soiled Taupo Plains, are covered with a bush growth including much bracken or fern. European introductions of plants have been extensive, and in some closely settled areas the native plants are seldom seen. Apart from timber, indigenous vegetable products of economic importance are few. Phormium, or New Zealand flax, flourished in swampy areas, but has been largely cleared. The Maoris introduced the kumara (yam) and taro, and ate also fern-roots.

The fauna is equally interesting. At the time of discovery the only land mammals in New Zealand were a dog and a rat, believed to have been brought by the Maoris, and two kinds of bats, probably blown over from the Australian region. There are no snakes, lizards being the only reptiles, one of which—the tuatara—is the most ancient of existing vertebrates, its relatives having died out in Europe in Mesozoic times. The absence of beasts of prey led to an extraordinary development of flightless birds; of these the gigantic moa was exterminated by the Maoris, while the kiwi is now found only in densely wooded districts. Whales and seals were formerly abundant in the surrounding seas, but the early history of New Zealand records their decimation. Fish are fairly plentiful, schnapper and flounders being noteworthy, but no large fresh-water fish are native to New Zealand. The introduced fauna is, of course, extremely important, and, apart from domestic animals, there may be noted the introduction of red deer and trout for sport and of stoats and weasels to prey upon the rabbit; stoats and weasels, however, seem to have had a greater effect in reducing the number of native birds.

Mineral Wealth. From the variety of rocks, both sedimentary and igneous, found in New Zealand, as well as from the folding and faulting that have taken place, it may well be expected that the Dominion has considerable and varied mineral wealth. Actually many minerals of economic importance are known to exist, but with one or two exceptions their scattered occurrence and comparatively small yield suggest that there is no great scope for important mining industries. Coal, gold, and fossil kauri gum—the last is

officially classed as a mineral—together with building-stone, constitute the significant output.

History and Development

Between Tasman's visit in 1642 and Cook's first exploration in 1769 New Zealand had been completely neglected, and it was not until nearly eighty years after this that systematic settlement began. In the meantime, toward the end of the eighteenth century, whaling ships developed a considerable industry, working from the Bay of Islands. Sealing became another prominent activity. These two occupations declined during the early part of the next century, when timber and flax attracted traders; missionaries and a number of pioneer settlers established themselves, but the British Government took no particular cognizance of this unregulated activity until 1833, when a Resident was sent from New South Wales, the Government of which had nominal jurisdiction. Somewhat lawless conditions and increasing restiveness on the part of the Maoris continued, until in 1839 the New Zealand Company, on the initiative of Edward Gibbon Wakefield, was established to make settlements on the lines of the 'Wakefield colonies' of Australia; in 1840 the first of these, Wellington, came into existence, followed by Wanganui, New Plymouth, and Nelson. There were later two other Wakefield settlements—Dunedin and Christchurch—established by 1850, and the Scottish atmosphere of the former in contrast to the English character of the latter is testimony to the origin of their early settlers. The centre of administration, at first established at Auckland, was later transferred to Wellington.

The pioneer colonies struggled against isolation, natural difficulties, and unsympathetic government, and were compelled to aim at self-sufficiency. Wider interests were opened up when sheep-farming began to develop on the grasslands, especially on the eastern side of South Island; by 1850 wool had become the staple export, and the next twenty years saw an enormous increase in the number of sheep. The gold rush to Australia in the fifties helped New Zealand by pro-

viding a near-by market for agricultural and other products, but the attention of many gold-seekers was directed to New Zealand in 1861 by the discovery of the metal in Gabriel's Gully, near Tuapeka, in Otago. Other fields in Otago and Westland were discovered, and Hokitika flourished as the leading port. By 1869 the boom was over, but the population grew from barely 100,000 in 1861 to 250,000 in 1870. Much capital was brought to the country, and agriculture was stimulated, but the immediate sequel of the decline of gold was a period of great economic difficulty. South Island, especially Otago and Canterbury, had received a far greater stimulus than North Island, and the latter was also severely handicapped from 1860 to 1872 by the Maori wars, which largely arose from the conflicting interests of the natives and whites in connexion with the land.

By the third quarter of the century a good deal of attention was given to wheat-growing, but the interest of settlers was diverted by the coming of refrigeration in 1882, which by providing an outlet for mutton as well as wool further developed the pastoral industry. The rise of dairying as an outstanding activity came later, but is attributable to the same cause, and an important result has been to stimulate the farming development of North Island, with its somewhat more favourable terrain and climate, more than that of South Island, so that since the beginning of this century North Island has outstripped the other in population.

A feature of the political development of New Zealand has been a strong provincial feeling. The early settlements were scattered; each was mainly dependent upon its own efforts; communications were difficult, and a more or less parochial outlook inevitably arose. The Constitution that gave New Zealand effective self-government, the first General Assembly of which met in 1854, also set up six provincial Governments, with power to legislate except on certain subjects. The provincial outlook is now much modified. These provincial Governments were abolished in 1876. Wellington, clearly from its central position a more suitable centre than Auckland, became the capital in 1865, and the title of Dominion was conferred in 1907. New Zealand might have entered the

Australian Commonwealth, but decided, mainly on the ground of distance, against that course.

The isolated position and the physical conditions of the Dominion have combined to determine the course of economic development. With a limited home market and high

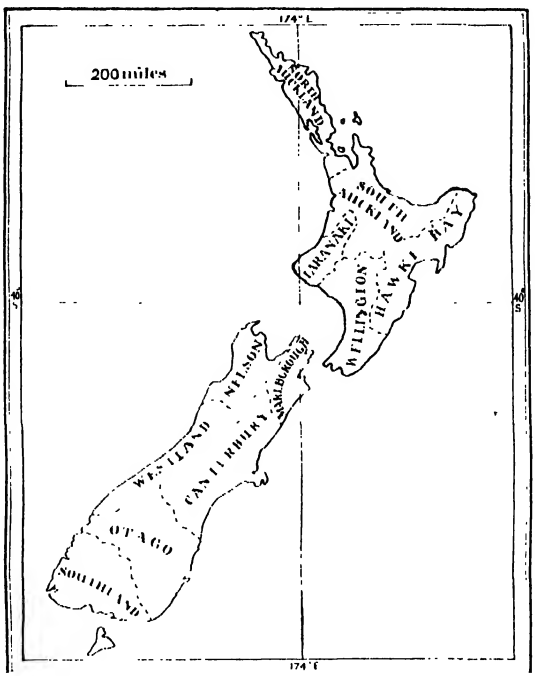

FIG. 131. NEW ZEALAND—LAND DISTRICTS

This map will assist in the consideration of some of the statistics given in the text.

transport costs, manufacturing industry cannot be expected to develop on any substantial scale, though it is noteworthy that the employment of the enormous resources of water-power would permit of such development, besides allowing for the conservation of the coal resources. Primary products which must be marketed mainly in the United Kingdom are the chief interests, and these are products which are favoured by the natural conditions. Not being specially endowed with

mineral wealth and not well able to compete with the extensive agriculture of other developing areas, New Zealand exploits her favourable conditions for rearing sheep and dairy cattle, and the products of the pastoral industry constitute the vast bulk (94 per cent. in 1928) of the total export trade. Though naturally favoured in this connexion, the Dominion, in view of its world position, would hardly be able to maintain a trade which is greater *per capita* than that of any other country in the world if the most careful attention were not given to the problem of holding markets by maintaining and raising the high quality of its products. Careful breeding for the mutton market and State supervision of the dairy and other food products, together with a considerable development of co-operative methods, must be reckoned as contributing to the economic position that New Zealand has attained.[1]

Population. New Zealand made a late start in settlement, and its remoteness added to the difficulties. The decline of gold, which had brought many who remained to colonize, was immediately followed by a vigorous policy of assisted immigration, but since then the natural increase in the population has been mainly responsible for the advance. By the end of the nineteenth century the population numbered about three-quarters of a million; since then it has doubled, and the population of New Zealand proper is estimated at nearly 1,500,000, including some 66,000 Maoris.[2] It is of interest that this is a smaller population than that of Victoria, although New Zealand has a substantially larger area. The birth-rate has declined, but the death-rate (8·5 per 1000) is the lowest in the world. All but an insignificant minority are of British origin, and more than three-quarters are New Zealand born. There are restrictions upon 'race aliens,' defined as persons of other than European race; the principal groups of 'race aliens' are some 3000 Chinese, 1100 Indians, and 1000 Syrians.

[1] See *New Zealand in the Making*, an important economic survey, by J. B. Condliffe (1930).

[2] The total population of the Dominion proper was estimated to be 1,488,595 on April 1, 1930.

Excluding Maoris, the population of North Island numbers about 880,000 and of South Island (including Stewart and Chatham Islands) about 530,000, distributed (April 1, 1929) as under:

	Provincial District	Population	Density per Square Mile
North Island	Auckland	449,307	17·72
	Hawke Bay	68,530	16·16
	Taranaki	69,920	18·74
	Wellington	290,180	26·80
South Island	Marlborough	18,630	4·41
	Nelson	51,880	4·77
	Westland	15,930	3·26
	Canterbury	222,964	16·09
	Otago		
	Otago portion	150,360	10·77
	Southland portion	67,260	5·02

There has been a considerable drift of population in recent years from South Island to North Island, largely owing to the development of the dairying industry in the latter, though this has not been sufficient to show an actual loss of population to South Island.

As there is a mean density of non-aboriginal population of 13·6 to the square mile it will be seen that each provincial district in North Island exceeds the average, but only in Canterbury is this true of South Island. The importance of relief and climate is broadly emphasized by the population figures. North Island, with its generally lower relief and more favourable climate for the pastoral industry, especially for dairying, which necessitates somewhat closer settlement, leads in numbers of population, and shows a more even distribution. South Island has great areas of mountainous and waste land, which show a low density, the greatest concentration occurring on the plains, notably the drier plains of Canterbury and Otago.

New Zealand shows a drift of population to the urban centres, which is a feature now found in many countries.

This has been discussed earlier in this volume in connexion with Australia. The following census figures illustrate the trend in the Dominion:

Census	Rural (Percentage)	Urban (Percentage)
1881	62·34	37·66
1906	57·96	42·04
1911	57·07	42·93
1916	54·18	45·82
1921	51·23	48·77
1926	48·38	51·62

A number of causes contribute to this. Among them may be mentioned the growth and organization of commerce, the tendency to develop secondary industries in urban areas, the extension of the activities of the state and of local authorities, but above all the improvement in the technique of farming, which permits the maintenance and even the increase of primary production without a corresponding increase in the labour-supply. It should be noted also that the increase of the rural population is still hindered by the large number of land-holdings of considerable size which are not subdivided among tenants, so that, despite many efforts to increase the number of smallholdings, some 40 per cent. of the occupied land is still held in areas of between half a square mile and eight square miles, while another 32 per cent. of the occupied land is in holdings exceeding this area.

The problem of urban drift is not so acute in the Dominion as in Australia. The urban percentage of population is not so great, and, if Victoria be taken as providing the nearest comparison, the capital city of New Zealand concentrates a very much smaller proportion of the people than does Melbourne in the case of the Australian state. The configuration and development of New Zealand in fact prevents the domination of any one city, so that, while there are four really large urban areas, not one can challenge comparison in its concentration with that shown by the state capitals

in Australia. With included suburbs the population of Auckland is 210,000, followed by Wellington (134,000), Christchurch (126,000), and Dunedin (85,000). The next largest town is Wanganui (28,000).

The Maoris. The indigenous inhabitants colonized New Zealand probably about five hundred years ago. They are Polynesians who, according to their traditions, migrated in large canoes from Hawaiki, the location of which is uncertain,

FIG. 132. A MODEL PAH, OR MAORI VILLAGE
By courtesy of the High Commissioner for New Zealand

and they seem to have absorbed an earlier and probably Melanesian race. By the time of the European discovery the Maoris had become the most vigorous and numerous of Polynesians.

Physically the Maori is a fine type, tall and muscular, with a light brown skin and black and generally wavy hair. The nose is broad and flattish. Though ignorant of the use of metal and the art of the potter, the Maori was an intelligent craftsman and a skilled fisherman and hunter, besides cultivating the roots kumara and taro.

The carving on canoes and houses was often elaborate and decorative; similar ornamentation of the face and body by

tattooing incised lines blackened with soot and other substances was common. Phormium provided material for clothing and baskets. Organized in large tribes, the Maoris lived in considerable fenced villages. Tribal warfare and cannibalism were common: warfare was aggravated by European firearms, and alcohol and disease helped deterioration. Elaborate customs relating to the holding of land were responsible in a large measure for the warfare between the settlers and the Maoris.

But the Maoris of to-day do not constitute merely a romantic survival. Of the total of 66,000, some 63,000 are in North Island, very largely in the Auckland Peninsula and Poverty Bay regions. Their numbers are increasing, and, what is more important, a revival of vitality seems to be taking place under the influence of wise native leadership and Government co-operation with the chiefs. Barely 4,500,000 acres of land remain to them, unequally divided among the tribes as regards amount and value and much of it poor, notably in the pumice areas. Maoris supply a certain amount of labour, both skilled and unskilled, outside the tribal areas, and with the right of equal citizenship (with four Maori members in the House of Representatives) it is not surprising to find distinguished Maoris in many walks of life. Where co-operative methods are possible some tribes have made considerable economic advance, and pastoral farming and dairying are carried on in a manner comparing favourably with white practice.[1]

Economic Activities

New Zealand is primarily a grazing country, and is likely to remain so. Cultivation is mainly concerned with local needs, and considerable quantities of food-crops and fodder-crops are raised, the modern dairying industry in particular necessitating a good deal of mixed farming. Mining activities are not large in comparison with farming occupations, and much of the factory development is concerned with treating

[1] *The Long White Cloud*, by W. Pember Reeves (3rd edition, 1924), is still a standard general work on New Zealand.

primary products. The extension of farming has involved wholesale destruction of forest, and the clearing of bush country in North Island is still going on with the development of the dairying industry. The Maori wars brought about considerably increased knowledge of the topography of interior districts, and since that period the cutting down and burning of timber and the planting of the cleared land with European grasses has led to more or less intensive mixed farming.

Forestry. Land clearance, fires, and sawmilling have reduced the forests to about 19 per cent. of the area, and much of this has a cover too poor for commercial exploitation. The kauri forests of the Auckland province have largely disappeared, the remaining areas being under State control. The most extensively worked timber is rimu, or red pine, found in both islands, but principally milled in the western and southern portions of South Island; it is a soft and not very durable timber, but locally important. Totara and matai, or black pine, are more durable, the former for joinery and the latter for weatherboarding, and are found in many parts, notably on the pumice lands of North Island. These woods have to compete with imported timber. Kahikatea, or white pine, common on alluvial flats in South Island, yields a softwood suitable for boxes, but suffers from the competition of substitutes. Silver beech, extensively found in South Island, yields a hardwood suitable for wine-casks and rifle-butts.

The State is now actively engaged in investigating the uses of native timbers, in conserving the remaining forests, and in encouraging afforestation. There are various State plantations, including a large one in the Rotorua district. *Pinus insignis* (Monterey pine), so commonly planted in Australia, is the species generally favoured.

The exports of New Zealand timber have tended to decline in recent years. In 1928 they were valued at £377,000, and consisted chiefly of kahikatea. Imports, largely of American softwoods, with considerable quantities of Australian hardwoods, reached a total value of £750,000.

Stock-rearing. New Zealand, with (at the end of 1928)

FIG. 133. NEW ZEALAND LAND UTILIZATION

From "Forestry in New Zealand" (New Zealand Government)

29,051,382 sheep (including lambs), ranked sixth in the sheep-rearing countries of the world, a remarkable fact having regard to its small area.[1] During the same year 9,705,118 sheep and lambs were slaughtered at registered abattoirs. Cattle numbered 3,445,790, of which 1,371,063 were dairy cows; nearly half a million cattle were slaughtered. Other stock consisted principally of 299,000 horses (a declining number) and 557,000 pigs.

The Importance of Soil and Climate. The distribution of plain land has a marked bearing upon stock-rearing and agriculture. Dairying and agriculture are largely, though not entirely, plain land and valley occupations, but the sheep industry occupies also upland mountain pastures of not too great elevation. Thus sheep show a wider extension than cattle, but there are remarkable differences in the density distribution. This is particularly well marked in North Island, where the great concentration of cattle in the dairying districts round Mount Egmont and in the Waikato and Thames Plains coincides with a low density of sheep.

The soil of the plains is varied and generally good. The plains of Southland are stony in parts, but well above the river-levels there is usually found a good loam soil. The extensive Canterbury Plains, having in many parts the appearance of rolling down country, are similar, but have fewer and smaller patches of poor soil, while the valleys of Central Otago, if small, contain good alluvial soil. Other plains of a fertile character are found in the hinterlands of Nelson and Blenheim, but the Westland Plain is under the handicap of heavy rainfall and much forest.

In North Island there are similar plains of fluviatile origin round the Manawatu river, in the Wairapapa Plains, and round Hawke Bay. The limestone downs behind Hawke Bay provide excellent sheep country. Pumice alluvium brought down from the volcanic area and deposited in the Middle Waikato basin yields a somewhat thin, often swampy soil; with modern treatment it makes good farming land,

[1] The figures for the countries which lead New Zealand in this respect are: Russian lands, 124,000,000; Australia, 106,000,000; United States, 47,000,000; Union of South Africa, 40,000,000; Argentine, 36,000,000.

especially for dairy cattle. The plains of Taranaki, of relatively recent marine deposits, stretch—often at a considerable elevation—northward to the west of the Ruapehu region, and the extensive flat areas between the rather deeply cut valleys have now largely been cleared of the original forest for farming purposes. The volcanic plateau, mainly covered by loose and porous pumice, although from the

FIG. 134. FOREST CLEARANCE IN THE NELSON DISTRICT
The stumps are not cleared; grass is planted and dairying begun at once.
By courtesy of the High Commissioner for New Zealand

chemical point of view well adapted to plant life, suffers from its porosity, and is still largely in its native state, covered with fern and scrub. The higher sheep pastures, especially in South Island, cannot be used except under the native grasses.

Climatically the Dominion is greatly helped by the mild winter and well-distributed rainfall that characterize it. Growth is to all intents and purposes continuous, and although the continuity of production of milk and mutton necessitates the production of fodder-crops for winter use, this can be done generally on the farms as part of the

ordinary routine, and stall-feeding is practically unknown. North Island is the more favoured in this respect, which to a large extent accounts for its greater importance in dairying. Much more clearing of forest was necessitated in North Island, for it lacked the large areas of rolling grassland so conspicuous in the eastern half of South Island, but the heavier rainfall of North Island, which was responsible for the thick vegetation cover, has been of enormous value for fodder-growth. On many small dairy farms the pasture is economized by the holding being divided into relatively small sections, grazed in rotation by the cows; the climate generally ensures that the grass recovers before it is again needed. The bulk of the occupied land is used for grazing, which occupies 31,000,000 acres as against 1,750,000 acres under all crops. Of the grazing land well over half is under artificially sown pasture grasses, leaving only about 45 per cent. under tussock and other native grasses. The proportion under sown grasses is steadily growing. In this connexion the cultivation of grass-seed is carried on on some 70,000 acres, principally, it is interesting to note, in the more invigorating climate of Canterbury, Southland, and Otago, and there is even some export of grass-seed.

The pastoral industry could hardly maintain itself without making use of modern methods, and a marked feature of recent years, apart from the general attention given to economizing labour, has been the increasing improvement of cattle pastures with a top-dressing of fertilizer. Superphosphate, basic slag, and lime are all used, especially the first; it seems probable that in time nitrogenous fertilizer will also need to be used.

Cattle and Dairying. Of the nearly 3,500,000 cattle about 83 per cent. are in North Island. In South Island they are more or less evenly distributed on the plains and in the valleys, with some greater concentration in the neighbourhood of Christchurch and in the volcanic Banks and Otago Peninsulas. In North Island they avoid the mountain areas and the volcanic plateau, and there are special concentrations in the lowlands of Taranaki and of the Wellington province and on the plains of the Waikato and Thames rivers. Con-

siderable numbers are bred for meat, not only for the home market, but for a substantial export of frozen beef. This

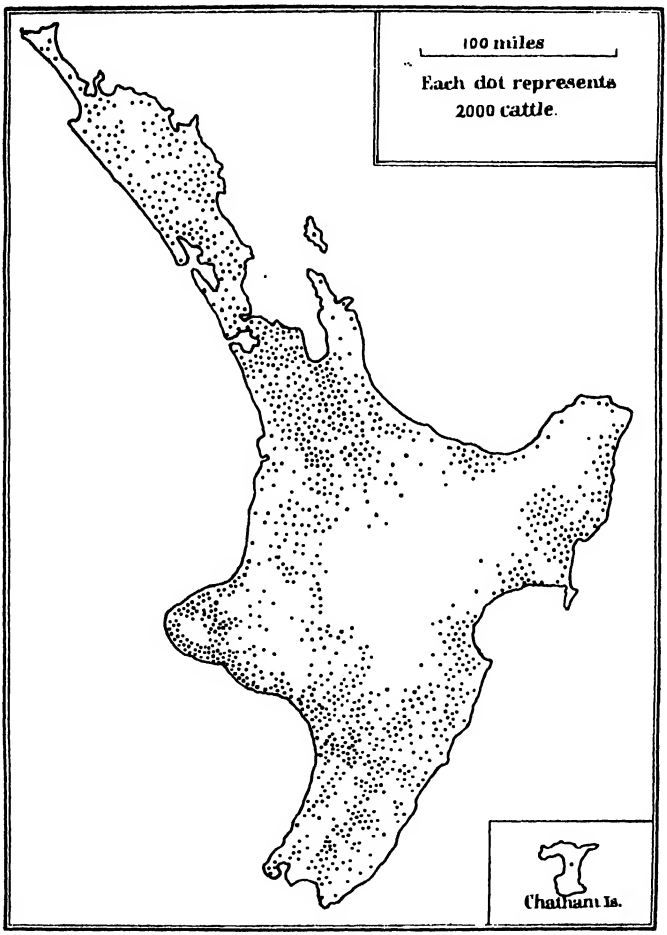

Fig. 135. North Island—Distribution of Cattle

export, however, maintains itself with some difficulty, owing to the competition of Argentine chilled beef in the London market.

The dairy cows, numbering 1,371,000, show a similar distribution between the two islands, and sufficient has been

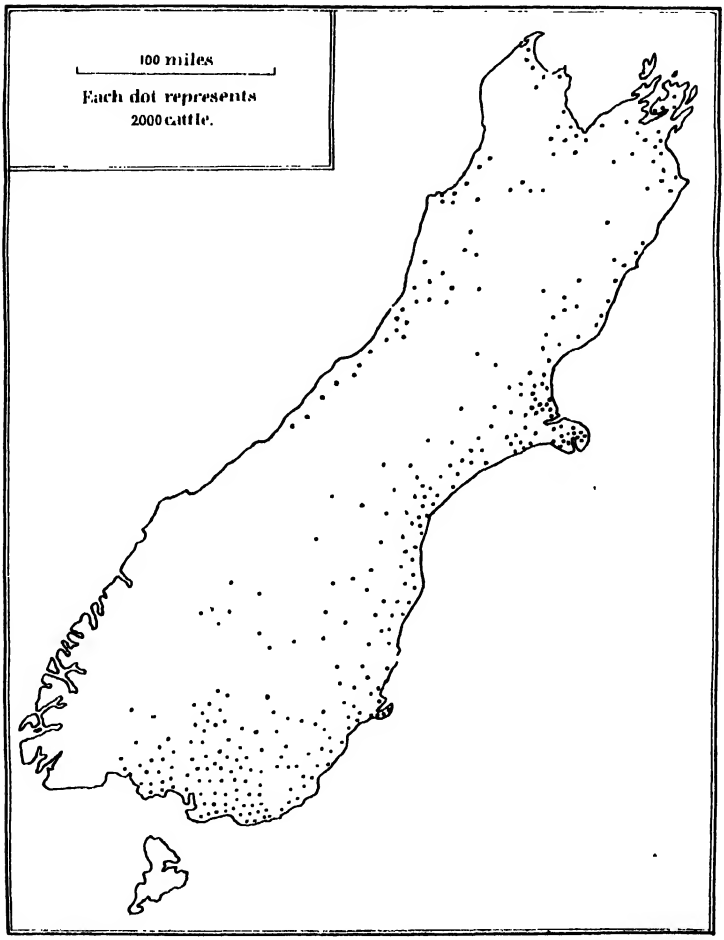

FIG. 136. SOUTH ISLAND—DISTRIBUTION OF CATTLE

said to suggest that dairying has made enormous strides in North Island. The most outstanding dairying area is found

in the Taranaki lowlands surrounding Mount Egmont, but the Thames and Middle Waikato lowlands, the area round Manukau Harbour, the lowlands between Wanganui and Palmerston North, the Wairapapa Plain, and the areas round Napier and Gisborne are all very important, and the industry is making rapid strides in the Auckland Peninsula. In South Island the most outstanding dairying districts are

FIG. 137. MILKING BY MACHINERY

Economy of labour is a marked feature of New Zealand's dairying development.

By courtesy of the High Commissioner for New Zealand

found round Christchurch, on the Banks and Otago Peninsulas, round the Kaikoura Mountains, and on the coastal lowlands of Otago and the Southland Plains. Dairying is of general importance in the eastern parts of the Canterbury Plains, not very well developed on the Westland Plain, but more so in the neighbourhood of Cook Strait, round Golden Bay, and in the Sounds district. It is of interest that in 1928 the number of dairy cattle varied from 122 per 1000 acres of occupied land in Taranaki to 6·3 per 1000 acres in Marlborough.

State encouragement, scientific breeding, co-operative methods, the milking machine (which greatly economizes

labour), and careful grading have combined to give the high reputation which is enjoyed by New Zealand dairy products, but this great industry, like that of frozen meat, was dependent upon the coming of refrigeration both for storage and transport. As a result of favourable conditions and an energetic and long-sighted policy at all stages of production and marketing, the dairying industry has almost caught up the sheep industry in the value it contributes to the export trade. Butter forms the leading product, but very large quantities of cheese, principally of the Cheddar type, and, like the butter, mainly produced for the British market, are also made. Milk is preserved and dried—an important present-day aspect of the industry; there is a considerable export, chiefly to the United Kingdom.

The Sheep Industry. The rolling downs and hill pastures of New Zealand are eminently suited to sheep, and they have a climate which as regards both temperature and rainfall is generally very favourable; even the considerable rainfall of North Island is not excessive. Apart from the kea—now confined to the high country of the north—there are no wild animals to prey upon the flocks. It is not surprising that the more open lands of South Island attracted the squatter, and it was here that the merino was introduced in the early forties of last century. But when it soon became evident that this type was not well suited to heavy plain lands British breeds were introduced. Nevertheless, it was the use of refrigeration that gave the tremendous impulse to sheep-rearing, for it made it possible to add the value of the carcass to that of the wool. North Island then took the leading position in sheep-rearing, which previously had made comparatively little progress there. Thus while in South Island the number of sheep increased by 3,500,000 between 1886 and 1929, in North Island in the same period it increased by 10,250,000. To-day North Island possesses 54 per cent. of the 29,000,000 sheep.

Breeding to suit the varied natural conditions and to subserve the production of both wool and meat clearly has been of the greatest importance. To-day the merino, which is not suited to confined areas and comparatively small-scale mixed

farming, is found chiefly on the high and sparsely grassed country of South Island, but it was the merino crossed with

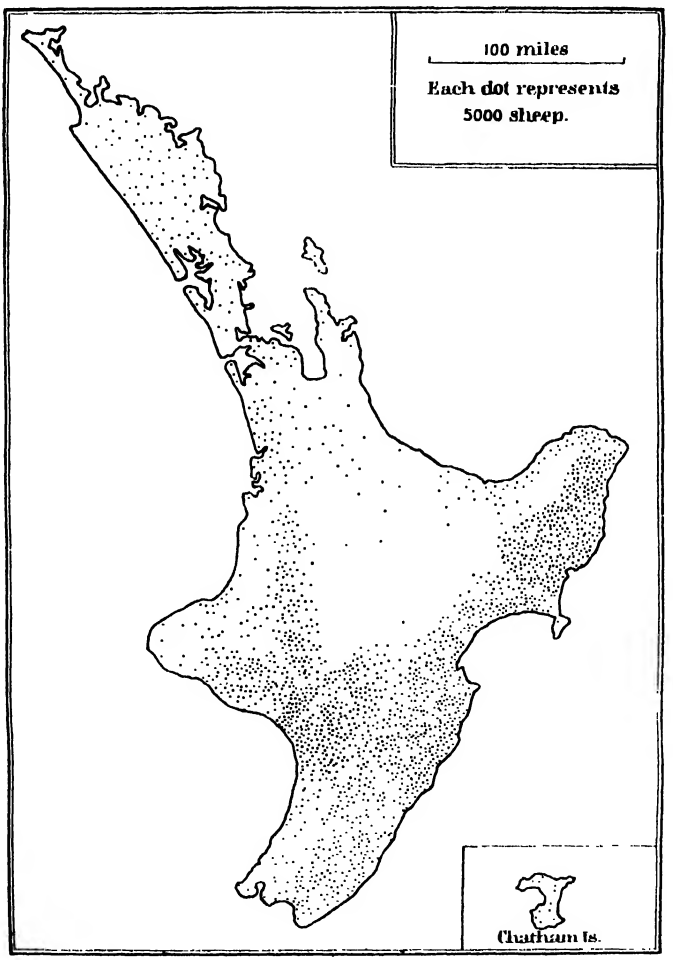

FIG. 138. NORTH ISLAND—DISTRIBUTION OF SHEEP

a British breed—Leicester or Lincoln—that built up the 'Canterbury meat' trade, and it is from the inbreeding of

such a cross-bred that the Corriedale—a New Zealand breed popular in South Island—has been developed. The moist

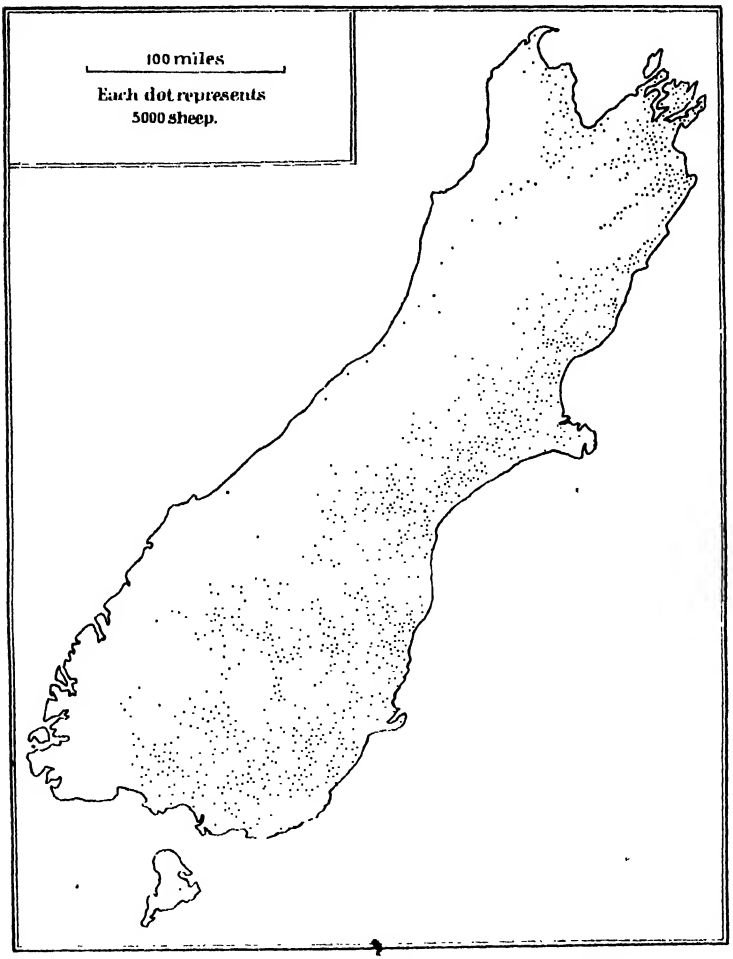

FIG. 130. SOUTH ISLAND DISTRIBUTION OF SHEEP

conditions of North Island, as well as of parts of South Island, have led to the popularity of the Romney Marsh

breed—very hardy and resistant to foot-rot. This sheep has been vastly improved by careful breeding, and it is noteworthy that among the pure-bred sheep in the Dominion this type predominates. To-day Southdowns are being increasingly bred for the fat lamb trade. More than 21,000,000 of the 29,000,000 sheep, however, are cross-breds, but the

FIG. 140. SHEEP STATION IN NORTH AUCKLAND
By courtesy of the High Commissioner for New Zealand

greater part of the merino strain in South Island leads to a larger production of fine wool than in North Island.

In North Island sheep are concentrated chiefly on the drier areas east of a somewhat irregular line drawn from Wanganui to Cape Runaway, with a moderate density elsewhere except on the volcanic plateau, which carries negligible numbers. The wet, rich soils of Taranaki, so famous for cattle, bear relatively few sheep. In South Island, excluding the high mountain areas and the wet west coast, where there are few, sheep are more evenly distributed over the plains

and valleys from the Waimea to the Southland districts, though it is noteworthy that on the Canterbury Plain the density thins out toward the Southern Alps.

As illustrating the wide variations in sheep density it may be noted that in a recent year the number of sheep shorn ranged from 1384 per 1000 acres of occupied land in the Hawke Bay land division to 40 per 1000 acres in Westland.

FIG. 141. SHEEP-DIPPING

The pole is used to push the head under the dip. New Zealand sheep are kept remarkably free from disease.

By courtesy of the High Commissioner for New Zealand

While the enormous sheep-runs of Australia are hardly found in New Zealand, the Dominion is not in a position to develop the sheep-wheat combination of mixed farming that is common in Australia. Nevertheless, there are many comparatively small-scale pastoralists, and of 26,712 flocks in 1929 nearly 12,000 were of fewer than 500 sheep, but these comprised only a small part of the total numbers. Half the sheep are in flocks ranging from 1000 to 5000.

Shearing begins in the lowlands about the end of October, and machinery is now generally employed for this work.

The wool clip, mainly sent away as 'greasy,' provides normally the most valuable single export, and finds its market chiefly in Western Europe. Mutton and lamb provide another large export. Some 7,000,000 carcasses have been exported in each of several recent years. The trade is carefully regulated, and the meat is graded, as are beef and dairy products, by officers of the Agricultural Department.

Before the days of refrigeration wool, tallow, hides and skins, and sundry by-products were the only products of the pastoral industry that could be marketed overseas. Refrigeration added meat, butter, and cheese to the list, and brought with it settlement and development and the employment of large numbers of drovers, shepherds, shearers, slaughtermen, and other workers. There are some forty freezing-works, while other dependent industries include butter- and cheese-making, fell-mongering and wool-scouring, tanning, boiling down, and manure-making.

Other Stock. Horses necessarily enter into farming work to a very large extent, and of nearly 300,000 in the Dominion it is not perhaps surprising that Canterbury is the land district containing the largest number (nearly one-fifth), as this area is of greatest importance for cultivation, while Westland has less than 1 per cent. Mechanical transport is leading to a distinct decline in the number of horses. Pig-breeding as an aspect of mixed farming has generally increased in recent years, and frozen pork adds a quota to the meat export trade, though the bulk of the product is consumed locally.

Bee-keeping, chiefly in dairying districts, has received a good deal of attention, and honey for export is subject to a supervision similar to that applied to dairy products. In general there is a somewhat growing export of honey, although its value is not large in comparison with the staple exports.

Fishing. The whaling so important in the early part of the nineteenth century has declined, so that only two stations now operate—one in North Auckland and one in Cook Strait. Hump-back whales are chiefly caught, but the total value of the product of the industry is small. Sealing is prohibited

except under licence from Campbell Island. In the general fisheries boats operate from most ports, but chiefly from Auckland, Wellington, Dunedin, and ports by the Foveaux Strait. Flounders are generally caught in shallow waters, schnapper are abundant in the north, and blue cod in the south. There is a small export, which is, however, of only half the value of the import of preserved fish.

At the time of discovery there was no fresh-water fish of

FIG. 142. HARROWING ON THE CANTERBURY PLAIN
Note the tractor and the extensive field.
By courtesy of the High Commissioner for New Zealand

importance. Trout and, more recently, salmon have been acclimatized for sporting purposes.

Crops. Of the occupied land by far the greater part is pasture under sown or native grasses. The cultivated area shows no tendency to increase; if anything, the movement is downward. Moreover, most of the cropped area is for fodder purposes. Agriculture's contribution to the export trade is insignificant.

The development of the pastoral industry in the eighties led to a decline in the acreage under wheat, and the area under this crop fluctuates considerably. Usually wheat has

to be imported to supplement the local supplies. The plains of South Island, with their drier and more temperate climate, dominate in wheat-growing, the Canterbury division alone in 1929 having 212,000 out of 250,000 acres threshed, Otago having the bulk of the rest, followed by Marlborough and Wellington; South Island therefore exports to North Island. It is noteworthy that the average yield per acre is high—over 30 bushels to the acre. Oats cover a larger acreage than wheat, and again the more temperate plains of South Island provide most of the crop, of which, however, less than a third is normally threshed, the remainder being used for fodder. Less than 10 per cent. of the total crop is raised in North Island; in South Island, in addition to Canterbury, both Otago and Southland contribute substantially to the total. A little barley is grown in these areas, and maize is a small crop, chiefly in the Auckland and Gisborne districts.

Other crops, apart from potatoes (principally grown in Canterbury) and peas (mainly in Canterbury and Marlborough), are raised to supplement grass during winter and the drier summer periods, though there is also a small but important area under hops in the Nelson district. Much grass is of course cut for hay, and the provision of ensilage is a growing tendency. Lucerne is grown to some extent for dairying purposes, and turnips are specially important, being grown for winter food for sheep; this crop has a greater acreage than any other.

Fruit. Commercial orchards cover some 18,000 acres, and apples, the principal fruit, are grown in all provinces. Cleared scrub lands in Nelson have proved very suitable, and yield 40 per cent. of the apple crop. Nelson has the largest acreage, followed by North Auckland, Otago, Hawke Bay, and Canterbury.

It is of interest that the irrigated valleys of Otago[1] are specially favoured for fruit. They are sheltered from strong winds, and together with a small rainfall have a warmer

[1] Practically all the irrigated land, covering 60,000 acres, is in these valleys, of which the Clyde valley is the most important. The bulk of the land is devoted to pasture for dairying purposes, but 2250 acres of orchards are irrigated.

summer than most parts of South Island; it is here that the leading crops of peaches, nectarines, apricots, plums, and cherries are produced. There is some production of oranges and lemons, chiefly in the North Auckland and Auckland divisions, where the climate is favourable, but, apart from apples, fruit is grown for the local market. A small area in

FIG. 143. MAORI WOMEN GATHERING FLAX, ROTORUA, NORTH ISLAND

By courtesy of the High Commissioner for New Zealand

the north-east of North Island is under vines, which are also cultivated under glass. Table grapes find a market in the towns, and a little wine is made.

Phormium tenax. This plant, which belongs to the lily family, is commonly referred to as New Zealand flax. It is one of the few indigenous plants of economic value. It grows readily in swampy areas, and its long, sword-like leaves yield a strong, coarse fibre. Historically the trade in it has had considerable importance. The product has to compete directly with Manila and sisal hemp, and the future of the

industry is uncertain. Nevertheless, some 62,000 acres of occupied land are under *Phormium tenax*, principally in Auckland, Wellington, and Westland. Some is worked up in local factories, but most is exported for manufacture into binder twine, cordage, and carpets. An important producing district is the Makererua Swamp south of Palmerston North.

Mining. Of the great variety of mineral deposits known, few have substantial importance. A large quantity of gold has been produced, but the alluvial deposits that brought about the rush of settlers in the sixties were not heavily productive for long; only a comparatively few payable reefs have been found, though the present yield is somewhat greater than it was at the end of last century. To-day the bulk of the gold output—valued annually at about £500,000—is the result of reef-mining in the mountains of the Coromandel Peninsula (where silver is obtained with the gold in the neighbourhood of Waihi), at Reefton, on a tributary of the Grey river, and in the Marlborough district. Alluvial gold is still obtained to some extent by draining and dredging methods, notably on the Hokitika river and near Ross, in Westland, as well as in Otago, where, however, few payable reefs have been found in the schistose rocks from which the alluvial gold was derived. Of other metals iron is the most important, and on Golden Bay an extensive deposit of limonite is now being worked; a blast furnace at Onakaka has commenced production. Although iron-production is at present subsidized, it has not yet been found possible to work commercially extensive deposits of ironsand found along the shore of the Mount Egmont peninsula. Scheelite for tungsten has been worked in Otago and various other metals elsewhere, but there is no significant production.

Coal, varying from anthracite to lignite (a small quantity only of the former), is found in a number of regions, but the reserves are not really large, and no individual coal-seam has been traced for any considerable distance, while many seams rapidly thin out. No coal of earlier age than Jurassic is known, and the bulk of it belongs to the early Tertiary period. The annual output is now about 2,500,000 tons, half of which comes from the Buller and Grey districts of South

Island. In these districts bituminous coal of excellent quality and even anthracite are found, and the State has collieries at Greymouth for supplying the railways. Elsewhere in South Island brown coal is worked, chiefly at Nightcaps, in Southland, and at Kaitangata, near the Clutha mouth, and lignite near Gore. In North Island some bituminous coal is found, but the chief production is of brown coal, notably near Huntly, on the Waikato, and in Northern Taranaki, while coal of an almost bituminous character is worked in North Auckland.

Kauri gum is officially classed as a mineral. It is actually a fossil resin, and has long been an important product of the northern part of Auckland. The diggers are largely immigrants from South-eastern Europe, and the fossil gum is used for varnish and linoleum, and is supplemented by inferior gum obtained by bleeding the tree. The export varies; in 1928 it was valued at £250,000.

Building-stone is locally important, and there is a considerable variety available of useful and decorative stone, especially of igneous origin. A notable area is the Coromandel Peninsula. Phosphate rock is worked in Otago, and small quantities of sulphur and pumice come from the volcanic region of North Island, the sulphur particularly from White Island. Extensive boring for petroleum has as yet yielded no profitable result.

Water-power. With high relief, a considerable and well-distributed rainfall, and no cold season, New Zealand has vast reserves of water-power in both islands. The State supervises development, and is itself actively engaged in providing electricity. Some 160,000 horse-power is developed at the present time, and no land district is without some supply of electricity from this source, the biggest development, however, being in Canterbury, Wellington, Auckland, Otago, Southland, and Taranaki, in that order. Besides supplying domestic users, power is used in the mining, dairying, freezing, paper, timber, and flax industries, and its further development will help to economize the coal resources.

The State hydro-electric stations, among which are the

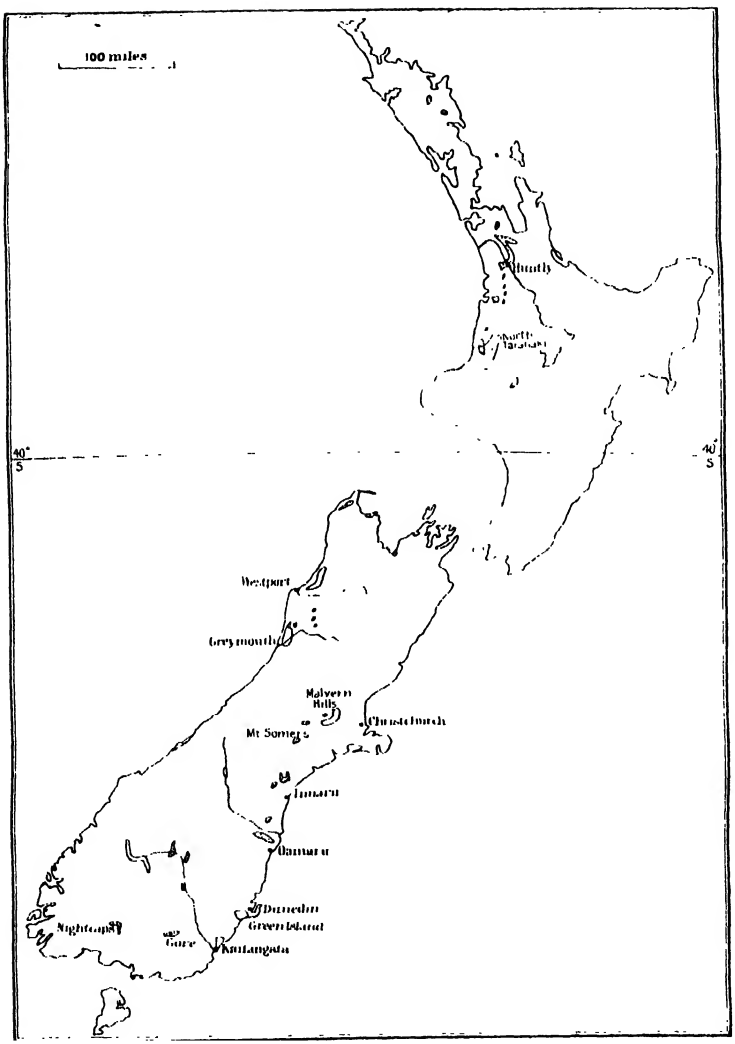

FIG. 144. NEW ZEALAND—COAL AREAS

For types of coal and production see text.

Based on a map of the New Zealand Government Geological Survey

largest in the Dominion, include the Hora Hora scheme near Cambridge, on the Waikato, the Arapuni scheme—a very large one higher up the river, the Mangahao scheme in Wellington province, the Waikare Moana undertaking in the hinterland of Hawke Bay, the Lake Coleridge works sixty-

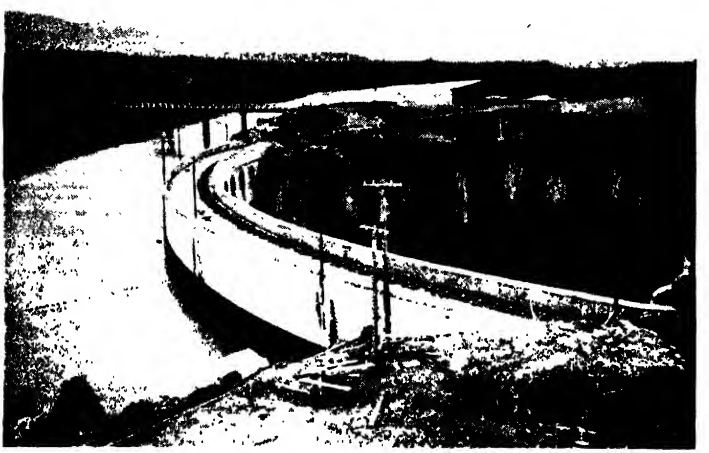

FIG. 145. THE ARAPUNI DAM

The Arapuni gorge is well seen, as well as the diverted river leading to the power-house. Since its construction, structural weaknesses have developed in the dam, but it is hoped to overcome these.

By courtesy of the High Commissioner for New Zealand

five miles west of Christchurch, and the Waipori scheme in Otago, thirty-two miles from Dunedin.[1]

Manufacturing Industry. With a small home market, manufacturing, as understood in Britain, has not attained any special development, and is mainly concerned with primary products. More than five thousand factories exist in the Dominion, but nearly 70 per cent. are establishments

[1] See "Hydro-electric Power Development in New Zealand," by R. O. Buchanan, in the *Geographical Journal*, May, 1930.

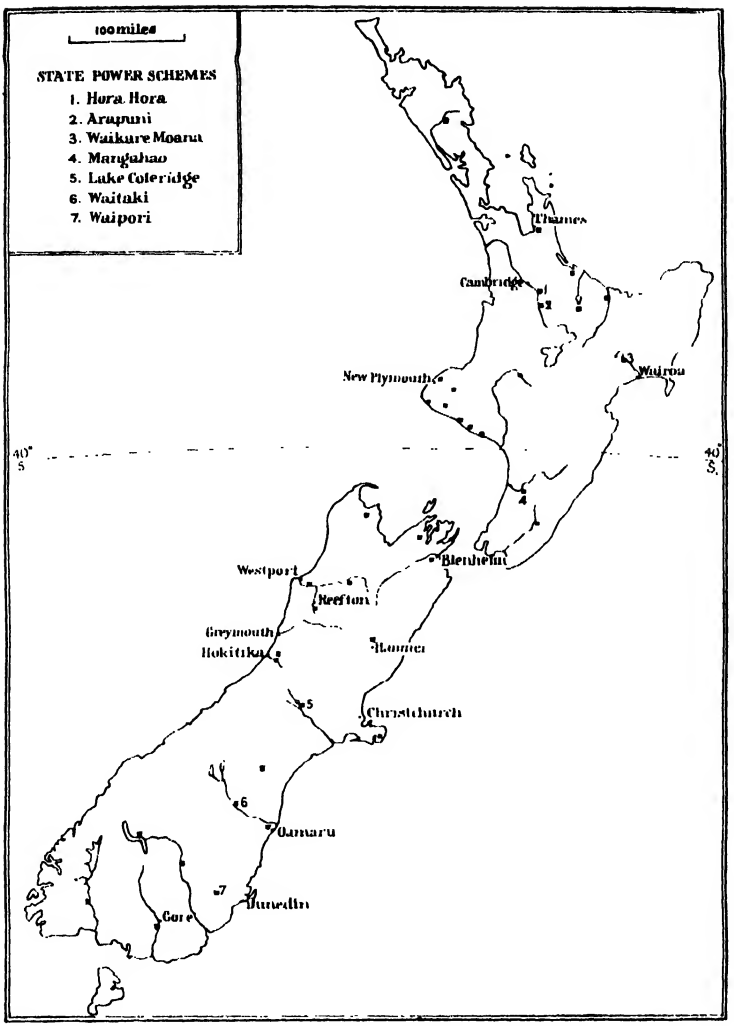

FIG. 140. NEW ZEALAND HYDRO-ELECTRIC STATIONS

The State power schemes include the largest in the Dominion.
Each black square represents a station; for convenience some towns are also marked.

Based on a Dominion Government map

employing ten or fewer persons. More than half the persons classified as industrial workers are in the Auckland and Wellington provincial districts, and generally the large factories are located in or near the bigger urban centres, but there is little evidence of the localization of industry such as is characteristic of old industrial countries. Having regard to the size and distribution of the population, and to the nature and extent of the resources, and to the isolated world position, it seems unlikely that New Zealand will develop large-scale manufacturing industry.

Many factories dealing with primary products are scattered about the producing districts. There are 500 factories producing butter, cheese, and condensed milk, more than 400 sawmills, and 70 flax-mills. Meat freezing and preserving concentrates, as would be expected, in large works at the ports. Of special note in connexion with the development of secondary industry is the existence of a substantial woollen manufacture, chiefly located in or near the larger towns of Canterbury and Otago. Many factories— engineering works, breweries, coachbuilding establishments, brick and tile works, and the like—have chiefly local importance, but a considerable production of leather, boots and shoes, clothing, and furniture should be noted.

Tourist Traffic. Few countries comprise within a similar area the scenic and other attractions of New Zealand. Of outstanding interest are the volcanic districts of North Island, the mountains, snowfields, glaciers, gorges, and lakes of the Southern Alps, where the beauty of the valleys is enhanced by a wonderful clothing of vegetation, and the fiords of the south-west, to which may be added the human interest of the native population, mainly found in the northern half of North Island. Unfortunately, the isolated position of the islands hinders the development of a large-scale tourist traffic from oversea such as is so important to Switzerland. Nevertheless, recent years have shown an annual traffic of some 13,000 tourists, attracted mainly from Australia, Great Britain, and the United States of America.

The Thermal District of North Island, as well as the Hanmer Springs of South Island, are of value for the curative

properties of their waters. Rotorua Spa is the most noteworthy development in this connexion.

Towns and Communications

A considerable and modern road-system is being developed, the total of metalled roads being now 50,000 miles. The more mountainous and hilly districts and the volcanic plateau are poorly provided with good roads, but motor-transport has led to a comprehensive policy of development. Some 200,000 motor-vehicles are registered, and investigation into the volume of freight carried during the month of July 1929 showed a movement of some 60,000 tons. This form of transport is much more developed in North Island than in South Island.

The configuration of the country favours considerable coasting trade, in which some 200 vessels are engaged. This coasting trade is largely in coal, but deals also in fruit, while the ports for oversea shipping are fed with export products by small vessels.

Railway-construction was begun at Christchurch in 1863, and a sporadic development on different gauges followed. Before this had gone very far the State took over railway development, and now there is a system of 3 foot 6 inch gauge totalling some 3300 miles, of which 1500 miles are in North Island and 1800 in South Island. Each island has a main line with branches, and there are in addition a number of short local lines. There are some 116 miles of private railway, chiefly serving coal and timber enterprises.

Wellington (population, with suburbs, 138,500), the Dominion capital, is centrally situated. It is built mainly on hilly ground on the west side of Port Nicholson, which possesses deep water, but the commercial part is on reclaimed land. Its immediate hinterland is the Hutt valley, but it commands the trade of a wide area rich in pastoral products, and serves as the oversea port for much of North Island, as well as for the Marlborough and Nelson districts of South Island.

In the value of oversea trade Wellington and Auckland

dominate, and share some two-thirds of the Dominion's total, while the coasting trade is very considerable. In Wellington and its suburbs, notably Petone, are various industries, including freezing-works, woollen mills, and railway workshops. The main line of North Island goes to Auckland. Leaving Wellington, it makes its way to the important centre of Palmerston North (population, 20,000), some twenty miles

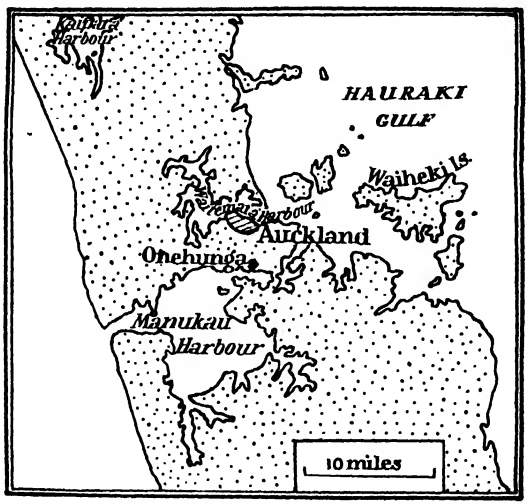

FIG. 147. THE POSITION OF AUCKLAND

up the Manawatu river. Palmerston North commands the Manawatu gap between the Tararua and Ruahine mountains, and is the centre of a rich cleared bush area, with flax-producing land to the south of it. Farther north the similar but smaller centres of Fielding (population, 4300) and Marton (population, 2800) are passed through, and the railway then traverses upland country, the development of which it has largely made possible. Taihape (population, 2500) and Ohakune (population, 1550) are the result of this pastoral development; the latter lies south-west of the central volcanic peaks, which are largely accountable for the considerable rainfall, giving well-timbered country.

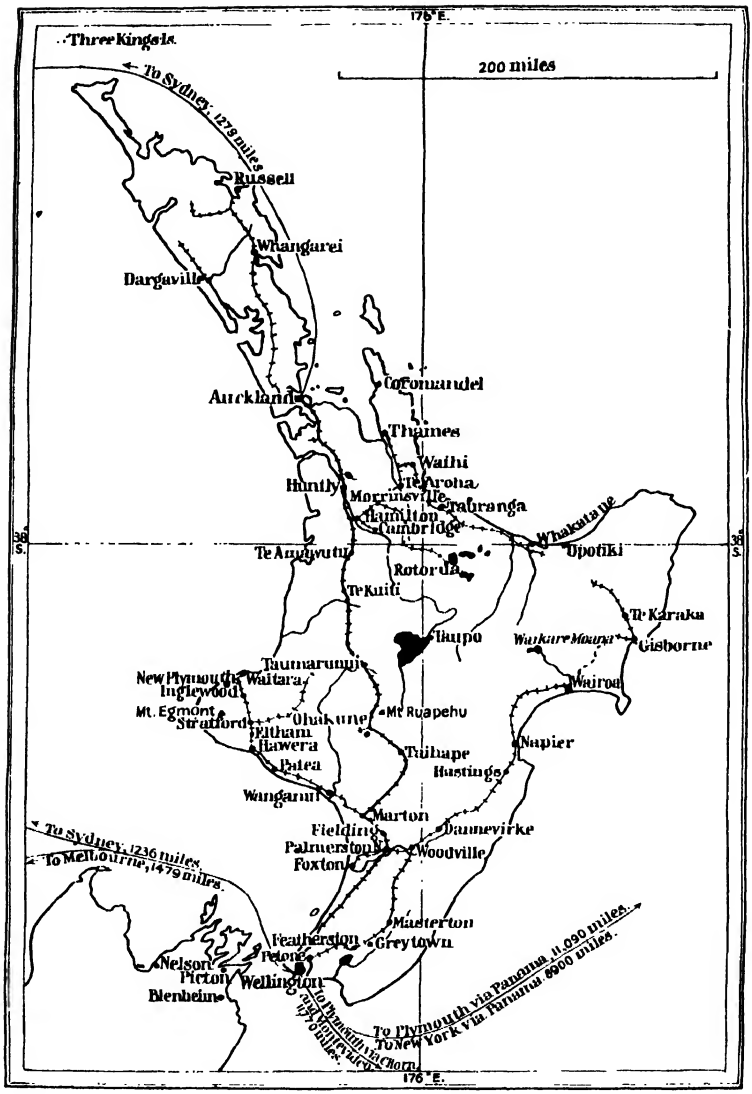

FIG. 148. NORTH ISLAND RAILWAY DEVELOPMENT

The railway proceeds, after climbing to 2636 feet, to Taumarunui (population, 2500), on the Wanganui, and enters the 'King country' (an area controlled by a Maori king during the wars), with Te Kuiti (population, 2500), near which are the famous Waitomo limestone caves. Beyond, Frankton Junction and Huntly (population, 1750), the coal-mining centre on the Waikato river, are reached. Farther north is Auckland (population, with suburbs, 213,500), the largest urban area. Situated on the deep-sea harbour of Waitemata, its suburbs reach to Onehunga, on Manukau Harbour, which is obstructed by a bar. Waitemata Harbour is an arm of the Hauraki Gulf; it possesses deep water at any state of the tide. The position of Auckland in regard to the great ocean-routes gives it command of a big oversea trade; it has regular services to Sydney, Far Eastern ports, Vancouver, the Pacific islands, and other parts of the Dominion. The dairying development of North Auckland has enhanced its importance, and, besides its trade in meat, dairy products, timber, flax, and gum, it has important fisheries, and possesses various industries, including sugar-refining.

From Wellington Napier may be reached either by way of Palmerston North and through the Manawatu Gorge or by another line which makes use of the Wairapapa Plain. By the latter route the Rimutaka Range is first crossed, involving a three-mile descent, with a grade of 1 in 15. The Wairapapa Plain is cleared land of great dairying value, while sheep are important in the bordering hills; Masterton (population, 8500) is the largest centre. Beyond Dannevirke (population, 4500) is remarkably good limestone sheep-rearing country, for which Hastings (population, 15,500), in an area in which fruit-growing is developing, is the chief market.[1] The chief

[1] A destructive earthquake in February 1931 caused the loss of more than two hundred lives in Napier and Hastings, as well as much destruction of property. Many other places, including Wairoa, were affected, though in a lesser degree. The disturbance seems to have been associated with the edge of the submarine plateau; among other effects, the sea-bed was raised, causing a shallowing in Napier Harbour, not sufficient, however, to prevent its use by shipping. Hastings appears to be rapidly recovering, but it is doubtful at present how far Napier will be able to return to its former prosperity. This earthquake is specially noteworthy in that deaths in New Zealand from these disturbances have hitherto been few.

drawback of this Hawke Bay hinterland is occasional drought, from which, however, the country rapidly recovers. From Hastings the line drops down to Napier (population, 19,100), which suffers from a poor harbour, despite the attempts to improve it, and to Wairoa (population, 2500), with the same disadvantage. Beyond Wairoa the line will go to Gisborne (population, 15,700), where Captain Cook

FIG. 140. UNCLEARED BUSH COUNTRY BEHIND GISBORNE, NORTH ISLAND

By courtesy of the High Commissioner for New Zealand

landed in 1769. Poverty Bay is now a misnomer, for the coast has rich flats, with fine sheep country behind, and freezing-works testify to the important pastoral industry. A railway penetrates inland from Gisborne, and helps to serve an area in which Maori farming is becoming important.

From Marton Junction, on the main line, a branch runs to New Plymouth. It passes through Wanganui (population, 28,000), at the mouth of the river of the same name; freezing-works and dairying factories in this district suggest its important pastoral industry, and the harbour of the city itself has been greatly improved. Similar facilities for dealing with meat and dairy products exist at Hawera (population,

4600), which is the centre of the rich dairying Waimate Plain. The line runs north, keeping east of Mount Egmont (Taranaki), passes through dairying centres such as Stratford (population, 3420), and after sending a short branch to Waitara (population, 1900), north of which there is as yet little settlement, reaches New Plymouth (population, 17,200). This important town is served by an artificial harbour near by, and serves an area of outstanding importance in connexion with the dairying industry. The district possesses unworked deposits of ironsand.

From Frankton Junction, south of Auckland, a branch runs through Hamilton (population, 17,500), on the Waikato, the principal centre of the Middle Waikato Plain, excellent dairying and sheep country. Beyond Hamilton the line goes to Morrinsville (population, 1600), the junction for a line to the Rotorua Spa and holiday resort, and turns northward to Thames (population, 4800), the port for the gold and granite of the Waihi district. Waihi itself (population, 3200) is on a branch that proceeds through Tauranga (population, 2700) and Whakatane (population, 1500) nearly to Opotiki (population, 1300). In the neighbourhood of these centres, on the Bay of Plenty and along the shores of the Firth of Thames, are considerable areas of drained land, and, besides dairying, pig-rearing, fruit-growing, and flax all have importance.

Two other North Island areas need comment. The first is the region north of Auckland, where the railway goes to Whangarei (population, 7100), the chief town of a somewhat isolated region, in which, however, settlement has in recent years made considerable strides. In this district gum is important. The line proceeds through a coalfield to the Bay of Islands, and turns west to Hokianga Harbour. The other area is the region round Lake Taupo, which is the centre of more than 8000 square miles of pumice land, with considerable timber resources on the more elevated parts. Taupo has attractions as a tourist resort, but is rather isolated, and the region as a whole awaits settlement, which will probably be dependent upon proper treatment of the soil.

In South Island the main line runs from Christchurch

to Invercargill. Christchurch (population, with suburbs, including Lyttelton, 126,000) is itself several miles from the

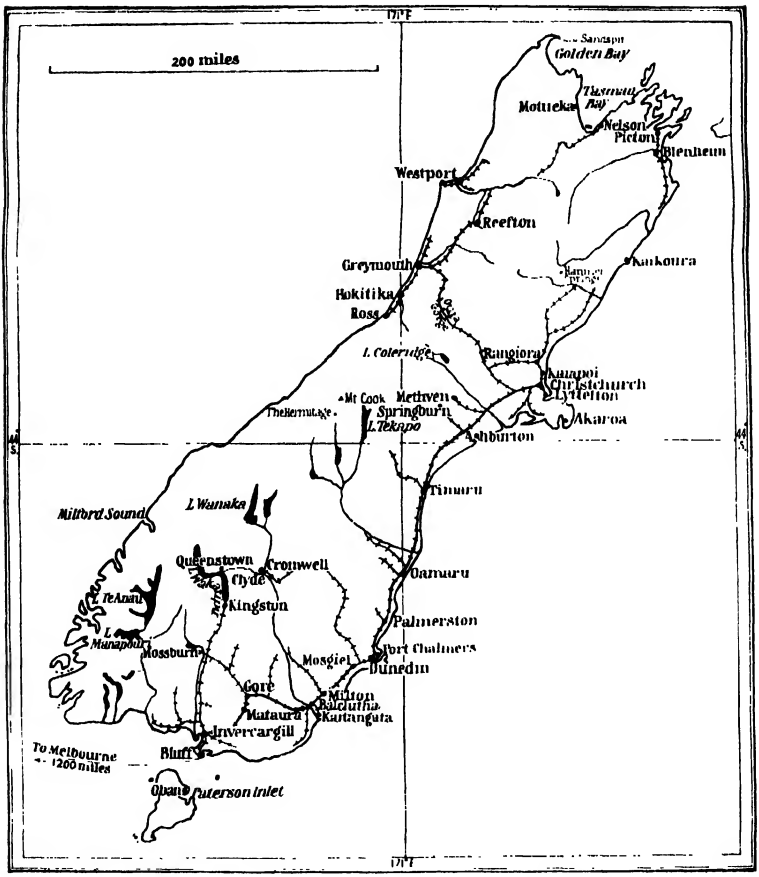

FIG. 150. SOUTH ISLAND— RAILWAY DEVELOPMENT

sea. Situated on the river Avon, it has developed into the chief centre of the most extensive plains of the Dominion. Port Lyttelton is dredged to accommodate ocean steamers, and in the suburbs of Christchurch and adjacent districts are great freezing-works, railway-workshops, and factories

devoted to agricultural implements, tanning, boots and shoes, woollens, clothing, and furniture, while electricity is brought from the Lake Coleridge hydro-electric station, lying to the west. To the south-east lies the volcanic Banks Peninsula; the coastal districts and lower slopes are largely devoted to dairying, with sheep pastures above.

Southward the railway passes through country partly agricultural, but largely devoted to fattening sheep and lambs marketed under the name of 'Canterbury.' Ashburton (population, 5300), on the river of the same name, has large freezing-works. The line reaches the coast at Timaru (population, 18,000), a large centre for the characteristic products and with a good artificial harbour, and enters the Waimate Plains. After the Waitaki river is crossed the Otago district is reached. Oamaru (population, 7500), in good sheep and cattle country, is hindered by a poor harbour. The next centre of importance is Dunedin (population, with suburbs, 85,000). This is a hill city, and developed considerably with the gold rush of the sixties; its harbour possesses 18 to 24 feet of water, though there is as much as 30 feet at the suburb of Port Chalmers. With railway-workshops in the district, various factories, such as woollen mills, at Mosgiel (population, 2000), coal near by, and electricity from the Waipori Falls some distance to the west, Dunedin exports wool, meat, dairy produce, and gold. Beyond, the railway passes the coal district of Kaitangata (population, 1500), and turns westward, to enter Southland, where Gore (population, 4000) is a considerable centre in a lignite area. The line reaches Invercargill (population, with suburbs, 23,500), which developed with the gold rush; it is largely built on reclaimed swamp. The district is important for sheep, cattle, and oats, while Bluff (population, 1600) is a deep-water port dealing in wool, meat, butter, and cheese.

Many short branches run from this main line, mostly to small interior centres. From Christchurch northward by the east coast the line does not go very far, but serves important agricultural land where Kaiapoi (population, 1700) has woollen mills and for which Rangiora (population, 2200) is an important market. Though going near to Hanmer Springs,

the railway does not penetrate the region of the Kaikoura Mountains. From the neighbourhood of Christchurch an important line runs north-west, and crosses into Westland by the Otira Tunnel, under Arthur's Pass; this section is electrified. Passing through magnificent, wild scenery, the railway reaches Greymouth (population, 6100). This port ships much coal, while its timber trade also is large. From it a coastal line runs through Hokitika (population, 2500) to Ross, both famous old centres for gold, some of which metal is still worked locally. Another line goes up the Grey valley and on through Reefton, while several short lines radiate from Westport (population, 4000), with resources similar to those of Greymouth and with some trade in butter.

The chief town of the Nelson district is Nelson (population, 12,300), with an inner harbour reached through a cutting in a long shingle bank. This is the most important apple district, for which product Motueka (population, 1250), on the opposite side of Tasman Bay, is specially noted, while there is good mixed farming in the Waimea Plains. In the Marlborough district the largest centre is Blenheim (population, 5300), situated in the Wairau Plain, with fine merino country on the adjacent hills. Picton (population, 1300), reached from Wellington along the Queen Charlotte Sound, possesses freezing-works, and is a tourist and fishing centre. More important, however, is the fishing from Kaikoura (population, 700), on the eastern peninsula of the same name.

The region of the cold lakes and the fiord district generally lack population, but attract considerable numbers of tourists. Mention may be made of the Hermitage, the centre from which Mount Cook (Aorangi) is reached, and of 'the finest walk in the world,' that from Lake Te Anau to Milford Sound. The fiords differ from those of Norway in the modification of their severity by a rich clothing of vegetation. As in North Island, the State railways and other transport agencies serve areas of scenic beauty of a variety scarcely paralleled in any other part of the world of similar size.

Stewart Island

This island, covering 662 square miles, is rather elevated, possesses an indented coast, a mild, moist climate, and a considerable amount of forest. It has no centre of population of any size. Once important for whaling and sealing, it now shares a substantial oyster-fishery in the Foveaux Strait. Some sheep are reared, and in summer it is visited by many tourists.

Other Islands

Mention was made at the beginning of this chapter of the islands included among the Dominion's possessions. The nearest may be mentioned here. The **Chatham Islands**, lying about 500 miles east of Lyttelton, cover 372 square miles, and contain a mixed European and Polynesian population of about 600. They are part of the Dominion proper. The pastoral industry—especially sheep-rearing—is well developed on the largest island of the group.

Six groups of generally rocky, mountainous, and uninhabited islands are classed as 'outlying islands,' with a total area of 2845 square miles. They are the **Three Kings Islands** —mere islets—some forty miles west-north-west of Cape Maria van Diemen; the **Auckland Islands**, the largest group, nearly 300 miles south of Bluff, mountainous, and possessing some excellent harbours; **Campbell Island**, to the south-east of the Auckland Islands, also mountainous, and with several good shelters; the **Antipodes Islands**—the antipodes of which are actually situated in the English Channel, some distance north of Le Havre—very isolated, to the north-east of Campbell Island; a little cluster known as the **Bounty Islands**, to the north of the last; and another called the **Snares Islands**, some distance south-west of Stewart Island. Except for the Bounty group the islands are well clothed with vegetation, with New Zealand types of flora; peaty moorland characterizes the higher parts. On each of these groups the Dominion Government maintains a depot of food and clothing in case of shipwreck.

The **Kermadec group**, 600 miles north-east of Auckland, is

more genial in climate, but, although settlement has been attempted, is unoccupied. The group consists of six islands, with a total area of about 12 square miles. The rich volcanic soil and moist, warm climate lead to a luxuriant vegetation.

The Cook Islands, the Union group, and the mandated territory of Western Samoa will be dealt with in the next chapter.

Trade

The large volume of trade shown by the accompanying table gave in 1929 a value per head of population of £37 5*s.* 10*d.* for exports and £33 1*s.* 9*d.* for imports, giving New Zealand the leading position in the world in this index of

	1928	1929
	£	£
Exports of domestic produce	54,660,365	54,176,013
Re-exports and specie	1,528,116	1,403,050
Total exports	56,188,481	55,579,063
Imports	44,886,266	48,797,977

trade. As an export market the United Kingdom stands out, having in 1929 taken goods to the value of nearly £41,000,000 —three-quarters of the total domestic exports. As a supplier the United Kingdom came first, but with goods to the value of about £22,500,000 was sending only about 46 per cent., the United States ranking second, with 19 per cent.

The leading exports in 1929 were wool (mainly 'greasy') (£15,360,000), butter (£13,229,000), cheese (£7,018,000), and lamb and mutton (mostly the former) (£8,577,000). It is clear that these items make up the major portion of the exports, and thereby show the overwhelming importance of the pastoral industry, further emphasized by exports of hides and skins (including hides, sheepskins, rabbit- and opossum-skins) valued at nearly £3,000,000, pork and beef each at over £500,000, sausage casings and skins at £653,000, tallow at nearly £700,000, and milk in various forms and casein at more than £500,000. With comparatively small exceptions,

including a considerable quantity of butter exported to Canada[1] and much of the beef, sheepskins, and sausage casings to the United States, these commodities went to the United Kingdom. Among the more important of the remaining exports were fresh apples, mainly sent to the United Kingdom, but with a useful market in South America

FIG. 151. PREPARING CARCASSES FOR REFRIGERATION
By courtesy of the High Commissioner for New Zealand

(£542,000), gold (£478,000), timber (£437,000), phormium (£340,000), kauri gum (£280,000), peas (£120,000), and honey (£83,000). Exports to Australia included timber, pork, phormium, peas, potatoes, and fish. Ships were supplied with coal to the value of nearly £250,000.

Among imports, New Zealand necessarily demands large quantities of manufactured goods—textiles, hardware, machinery and the like, oil, and such foodstuffs as she does not produce. Among foodstuffs may be noted as imported in 1929

[1] A trade likely to be much restricted by a recent change in the Canadian tariff.

tea (£922,000), largely from Ceylon, raw sugar (£720,000), including much from the Dutch East Indies, and wheat and flour (£227,000). The United Kingdom was the chief supplier of large quantities of a variety of manufactured goods, which included apparel and clothing (£3,100,000), cotton piece-goods (£1,780,000), tobacco and cigarettes (£1,350,000), boots and shoes (£1,065,000), woollens (£743,000), and large amounts of drapery, iron and steel goods, corrugated iron, pipes, fencing-wire, railway plant, chinaware, and electrical goods. The United States and the Dutch East Indies mainly shared the import of mineral oil, chiefly petroleum (£3,000,000), but Canada led the United States in the imports of motor-vehicles and parts (£5,700,000), in which the United Kingdom had only a small share. Among other imports of note were silk goods, mainly from the United Kingdom, Japan, and France (£1,211,000), bags and sacks from India (£558,000), timber, largely from Australia and North America (£586,000), phosphates, including rock phosphates from Nauru and the Gilbert and Ellice Islands and basic slag from Belgium (£631,000), other manure, chiefly sulphate of ammonia and nitrates (£190,000), whisky (£560,000), and musical instruments (£533,000).

The relative importance of the leading ports is illustrated by the following table for 1929 (oversea trade):

Port	Exports	Imports
	£	£
Auckland	14,721,526	15,730,475
Wellington	14,605,551	16,866,620
Lyttelton	5,559,808	6,886,144
Dunedin	3,739,025	5,003,528

Of other ports, the chief in order of value of total trade were Napier, Invercargill, New Plymouth, Timaru, Wanganui, and Gisborne; these are mainly exporting ports.

It is of interest to notice that Auckland shipped two-thirds of the butter, while Wellington led for cheese and mutton, Lyttelton and Wellington for lamb, Wellington, Napier, and Lyttelton for wool, and Westport for coal.

Auckland and Wellington are the leading ports for oversea shipping, and are also served—especially the former—by a large number of coasting vessels. Many of the smaller ports are not visited by oversea shipping, and the coasting trade is therefore an important aspect of transport.

Conclusion

The development of New Zealand shows certain similarities to that of Australia. Remoteness from the great markets of the world is even more marked; there is now no acute native problem; there is racial uniformity, intense national feeling, widespread State activity in the economic sphere, the same striving after a high standard of civilized life, and a similar drift of population to the towns.

Nevertheless, the smaller size of New Zealand, a generally more favourable climate, and a larger proportion of utilizable land have led to certain differences. Thus the population is much more evenly distributed, the pastoral industry is relatively more important and agriculture relatively less so, and the small local market has led to much less attention being paid to the development of secondary industries than is the case in Australia. There is the same tendency, however, toward fostering manufacture behind a tariff wall and the same ideal of self-sufficiency.

It seems probable that in the immediate future New Zealand will aim at consolidating her present position as a producer of primary products of high quality. The development of communications and power will doubtless be made to subserve this consolidation, and in view of the fluctuations in world prices for the typical exports (the recent slump in which has seriously affected the prosperity of the Dominion) and of the improving technique of the pastoral industry no great expansion of land settlement may be expected for some time to come.[1]

[1] In 1930 imports were valued at £43,026,000 and exports at £44,940,700. The fall in the value of the wool export alone was responsible for well over half of the decline in the value of the exports in comparison with the previous year.

CHAPTER IX

OCEANIA AND OTHER ISLANDS

A GENERAL account of the Pacific islands has been given in the first chapter. They have an estimated total area of 380,000 square miles and a total population but little exceeding 2,000,000 people. New Guinea alone accounts for 80 per cent. of the area, but for only a little more than 40 per cent. of the population. The islands are so scattered and numerous, many are so insignificant and isolated, that it is possible to deal only with the more important groups or with those that present features of particular geographical interest. Except for incidental references it is not intended to cover the Dutch East Indies or the islands north of the equator.

In surveying the map of the ocean and endeavouring to take an ordered view of the islands it is possible to regard them from more than one point of view. Thus a linear arrangement may be detected—New Guinea and New Caledonia indicate one great arc; farther east is a parallel line marked by the Bismarck Archipelago, the Solomons, and the New Hebrides; there is another arc from New Zealand to Samoa, on a branch of which rises the Fiji group; Samoa also seems related to the Tokelau or Union group and the Phœnix Islands; while farther east are three parallel chains marked respectively by the Cook Islands, Tahiti, and the Tuamotu or Low Archipelago. A more simple division is to separate the islands on the basis of the racial affinities of the indigenous peoples, which leads to a consideration of Melanesia and Polynesia (the line of division running east of Fiji), while a small portion of Micronesia, notably the Gilbert and Ellice Islands, comes within the area being particularly considered. On the basis of this division a certain mixture of types is involved. It may be noted that the

political affiliations are varied, although British imperial interests predominate.

From any point of view the scattered character of the groups is somewhat confusing. Here it is intended for convenience to adopt the second basis of classification.

History and Development

Some matters connected with the whole area may first be considered.

Oceania presents a rich field for the anthropologist, and it is not easy, under a fundamental similarity of language throughout the great area, to discover the origins of the different peoples who inhabit it. The Papuan physique,[1] African in type, is very different from that of the Polynesian, in which a copper colour is allied to tall stature and almost European features. On the other hand, the languages of Oceania all belong to the family known as Austronesian, and Polynesian is a derivative from Melanesian. Moreover, the type of civilization throughout Oceania is the same, although developed in the east to higher levels than in the west, where, as in New Guinea, the physical conditions are more difficult. The stone oven and woodcarving prevail from end to end, as does essentially the same type of canoe, while the village is everywhere the fundamental unit of social organization. Tribal and clan feuds still obtain in the west, and until the modern period elsewhere maintained strife within all but the smaller islands. Political organization was everywhere unknown. While the level of culture broadly rises from west to east, a point of interest is that the art of the potter is confined to Melanesia; it has been suggested that it died out among coral islands, which provide no raw material.

For long after the early discoveries European nations showed little interest in any part of the area. Indeed, it was not, broadly speaking, until the age of steam that political

[1] Many writers prefer to distinguish the Papuan from the Melanesian. There are, however, important physical similarities that make it convenient to use the term here to cover the inhabitants of New Guinea as well as those of Melanesia proper.

interest was aroused and European Powers, the United States, and the Australian colonies concerned themselves with claims to Pacific islands. Even New Guinea, first visited in 1526, was little known until the middle of the nineteenth century, and Dutch control of the west was until recently little more than nominal. The islands became the scene of the activities of whalers, traders, and missionaries, and, lacking any political unity, found it all but impossible to resist white encroachment. Until white political control was established—and this came only gradually, in the latter half of the nineteenth century—the conditions in the Pacific were chaotic, and often ruinous to the indigenous populations.

Trouble was caused not only by the activities of unscrupulous traders, but often inadvertently by well-meaning people. European diseases have taken and still take great toll of life, while the lack of understanding of the native social life and organization has been a frequent cause of trouble. More than one explorer, innocently cutting down coconut palms, has found himself attacked, not realizing the importance of the tree in the economy of the Papuan. The large measure of communism that prevails was little understood by Western minds, and the undermining of native customs in dress and in outlook has contributed to the decline of many of the islanders.

The history of Easter Island—remote in the Eastern Pacific—illustrates some of these points. About 40 square miles in area, with dormant or extinct volcanic peaks, it possesses about 250 inhabitants, mainly Polynesian in stock. It is believed at one time to have carried 3000 people; the remnant to-day suffers from tuberculosis. Discovered in 1722 by Jacob Roggeveen, it became the haunt of whalers, who more than once kidnapped islanders for work elsewhere. In the sixties Peruvian vessels seized many for their guano-diggings, but after French intervention a remnant of these —infected with smallpox—was sent back; phthisis was already on the island. An unscrupulous cattle- and sheep-raucher of French extraction was scarcely restrained by the activities of French missionaries, who withdrew after a time,

with 300 followers. Some 500 men were removed for ranching in Tahiti, and the population dwindled to 100. Chile intervened later, and bought out the ranching interest, but eventually withdrew. In 1914 a scientific expedition found a small, dirty, uncouth, and thieving community. With two lambing seasons, sheep multiply rapidly, but while a Chilean company interests itself in the island once a year, its political affiliations seem uncertain. It lies well off the Great Circle route from Wellington to Panama.

In connexion with the prevailing communism the conditions in Fiji, where the administration has left it largely undisturbed, provides an interesting illustration. The Fijian is a member of a tribal unit that owns the tribal land. He possesses the right to use the land for cultivation and for cattle-raising both for his own support and for profit. He lives in a hut provided by his community, and pays rent for neither house nor land. Should the tribe possess a coconut plantation, he shares in the profit, as he does in the rent of any tribal land that may be leased. He is in effect a smallholder, and is not generally dependent upon work outside the tribal area.

It is clear that from the point of view of supplying labour for plantation or other work the indigenous population does not provide a very profitable field, but there is plentiful experience to show the unwisdom of breaking up such a well-established social economy. It is therefore not surprising that the number of Indians in Fiji is within measurable distance of that of the Fijians themselves. Actually the Fijian is often willing to work for wages for a limited period, especially if he be desirous of securing some definite object not obtainable without this. As an agricultural labourer he is usually employed on a yearly contract, while he may provide casual labour at the docks or work on inter-island boats. The personnel of this labour supply is constantly changing, but tribal life is not seriously interfered with.

The acquisition of the island groups by the Great Powers was a relatively slow process. Doubtless Captain Cook's voyages established vague British rights over many, and traders were often British—for example, those attracted by

the discovery in 1804 of sandalwood in Fiji. Yet this group was not acquired until 1874, a notable event in the partition of the Pacific islands. Before this time France had evinced considerable activity, establishing protectorates over the Tahiti, Society, Marquesas, and other groups in 1842, following with the acquisition of New Caledonia and other islands in 1853. About the time of the American Civil War Fiji developed cotton-growing; this activity subsequently declined, and financial troubles were added to tribal warfare and difficulties connected with recruited labour. 'King' Thakombau, following a threat from the United States, had already in 1858 sought British protection, an offer that was refused. After the collapse of the cotton boom the Fijian whites—in financial difficulties—sought an American protectorate, which was also refused. In 1871 Germany, whose traders, notably the famous Godeffroy firm, were already in the Pacific, was seeking acquisitions, and in the following year a German warship visited Fiji. The fear of being forestalled was added to urgent requests from Australia and New Zealand and the outcry against the trade in labourers; a second offer from 'King' Thakombau was accepted by Britain, Fiji was taken over in 1874, and in 1875 became a Crown colony and the headquarters of the High Commissioner for the Western Pacific. Fiji was soon to become what had not previously been known in the Pacific, an area in which a European Government administered definitely in the interest of the native population.[1]

The United States had secured a footing in Samoa in 1872, and later in the century British and Australian distrust of German activities grew rapidly. Queensland was violently agitated when in 1884 Germany annexed New Britain, New Ireland, and North-east New Guinea, for she had already asked the British Government to be allowed to annex Eastern New Guinea. In the same year Britain annexed the south-east of that island; this was followed in 1885 by Germany taking the Marshalls and Solomons. In 1899 Britain agreed to give up her interest in Samoa, and various islands, including Upolu, with the port of Apia, became German; recognition

[1] See *Life in the Pacific Fifty Years Ago*, by Alfred Maudslay (1930).

of the American claims in this group was given at the same time. The Spanish-American war in 1898 led to the transfer to the United States of the Philippines and certain islands north of the equator. The only other important changes in political distribution followed the Great War, when the ex-German colonies were distributed as mandated territories between Australia, New Zealand, and Japan.

The control of the Great Powers brought about several results. The scandals of the labour traffic came to an end, paternal Governments have brought disease under some measure of control, and ordered development has to a large extent been brought about. The degree varies, and much of Melanesia is but little touched by development in the modern sense. Elsewhere non-indigenous labour is much in evidence; typical agricultural products entering into commerce are copra and sugar, but the importance of phosphates in certain coral islands and the picturesque attractions to tourists of "the South Seas" should not be forgotten. The development of shipping in the age of steam, the opening of the Panama Canal, and cable development have each added importance to certain islands or groups of islands, while the strategic value of some in relation to naval rivalry in the Pacific has only been modified by the results of the Washington Conference of 1922. With all this, the decline in numbers of the indigenous populations has at best been only stayed, and there is little evidence of the reinvigoration that has been noted among the Maoris.

Throughout the island groups various native languages persist, but the language of trade is *bêche-de-mer* English, a jargon of English and native words.

Melanesia

This term, signifying 'the Islands of the Blacks,' is here taken to include New Guinea and to cover also the Bismarck Archipelago (New Britain and New Ireland), the Solomon, Santa Cruz, New Hebrides, and Loyalty groups, as well as New Caledonia and the Fiji group—the last being the most easterly extension of Melanesia—and a number of smaller

islands. These islands exhibit a linear arrangement and are essentially continental islands showing the extension of former fold-mountain systems. The Fiji group stands apart in its higher cultural level, besides exhibiting a distinct admixture of Polynesians; small Polynesian colonies are also, however, to be found elsewhere, as in the Loyalty and New Hebrides groups. The political control is varied; the western portion of New Guinea is Dutch; the British Government has given over the administration of Papua (South-east New Guinea) to the Australian Commonwealth, to which Government also was given the mandate for the ex-German territories of North-east New Guinea, the Bismarck Archipelago, and the adjacent portion of the Solomon group; Britain controls the rest of Melanesia, with the principal exceptions of New Caledonia and the Loyalty Islands—both French—and the New Hebrides, the last peculiar in being under an Anglo-French condominium.

The Island of New Guinea

This, after Greenland the largest of the world's islands, covers an estimated area of 312,300 square miles, is nearly 1500 miles long, and has a population of about 900,000. To the west lie the Moluccas, separated from New Guinea by a rather deep channel; the continental shelf links the island to Australia. It is entirely south of the equator—approximately between that latitude and 11° S. A long central range[1] extends throughout its length, and with the snowline at about 14,600 feet one or two of the highest peaks (the maximum elevation is 16,400 feet) possess glaciers. This central chain, with a core of Primary and granitic rocks, passes under various names—Nassau, Bismarck, and Owen Stanley Ranges. To the north is a broken coast range (suggested in the west by the McCluer Inlet, lying between it and the main range), which is still rising; old coral reefs have been

[1] The interior of New Guinea, particularly the mountainous core, is little known. For an account of the first crossing of the main range, which took place at the end of 1927, see "Exploration in the Interior of Papua and North-east New Guinea," by C. H. Karius, *Geographical Journal*, October, 1929.

found at an elevation of over 5000 feet. A little volcanic activity is noticeable in the extreme south-east, and the mountains are generally flanked with Tertiary rocks; the lowlands—very extensive in the south—are mainly covered with alluvium.

Mean monthly temperatures at sea-level depart little from 80° F. The south-east trades prevail in the northern summer, and bring a heavy rainfall to the eastern end of the island, with a diminishing amount westward. In the southern summer the monsoon blows from the north, and heavy rain is general, though there is less by the Gulf of Papua than elsewhere. The rainfall in exposed places is very heavy; it is considerable in the lowlands, but these exhibit a tendency toward a dry season. The rivers are necessarily torrential, but the larger ones have their lower courses in alluvial flats. The chief are the Fly, draining to the Gulf of Papua and navigable for 600 miles by steam launch, and the Sepik (Kaiserin Augusta), up which sea-going vessels can penetrate for 180 miles.

The tree limit is probably at a height of over 10,000 feet; rain forest prevails except where the dry season is rather pronounced, as on some of the plains by the Sepik and Fly rivers, where tall grass is common. The vegetation necessarily varies with altitude; there are grasses, heaths, and rhododendrons above the forest level, with cypress, myrtle, bamboos, and evergreen oaks lower down. The lowland forests are typically equatorial. The flora includes gigantic banyan-trees, tree-ferns, and rare orchids; palms are numerous, and grass and cane swamps, as well as sago swamps, occur in the lowlands, with mangroves known to be rich in tannin in deltaic areas. The fauna includes eighty-four species of marsupials (including small kangaroos), crocodiles, wild boars, a number of snakes of Australian affinities, and birds of Paradise, for which the island is famous.

The Papuan—dark, short, long-headed, and frizzy-haired—is the prevailing stock, although tribes of allied Melanesians[1] from the islands to the east are found, as well as some negrito groups. The isolation of tribal groups has led to a

[1] Papuans and Melanesians have sometimes been grouped as Papuasians.

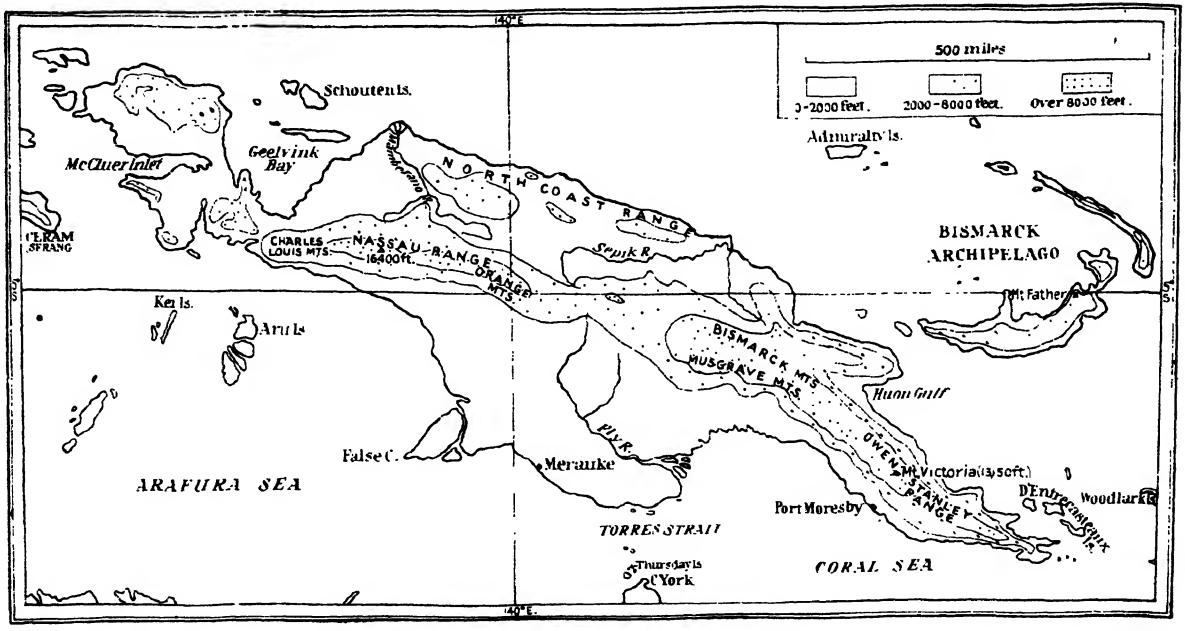

FIG. 152. NEW GUINEA—PHYSICAL

multiplication of dialects. Small-scale agriculture is carried on—coconuts, yams, taro, and bananas, with sago (notably in the west), are grown; the pig is both wild and domesticated, while fishing—including the harpooning of dugong—is important. Canoes are dugouts, houses frequently are pile-dwellings, clothes are made by beating out the bark of certain trees; the banana and coconut provide fibre. Pottery-making is general, betel-nut chewing prevalent, and religious

FIG. 153. COAST VILLAGE, PAPUA
Viewed from the coral reef. Note the long pile dwellings.
Photo R.N.A.L.

beliefs are at the sorcery level. The conditions of damp heat and dense forests and the absence of any considerable labour-supply lead to a very low density of population (which appears to be declining in at least some areas) and a very restricted development. Among diseases that are common may be mentioned malaria, dysentery, yaws, hookworm, filariasis, beri-beri, and pulmonary diseases.

Dutch New Guinea. With an area of 152,000 square miles, this covers nearly half the island. The estimated population is about 200,000, of whom some 250 are Europeans or Eurasians. The large area contains great mountains, alluvial river-flats, with vast swamps in the south. Hill tribes war with coast tribes, using polished stone axes and bone knives,

and head-hunting and cannibalism exist. As sago, the chief food, is obtainable almost everywhere, there is little incentive to agricultural development. Commercial activity is limited to a few coastal districts in the north and the part of the island facing Ceram. Copra is the chief article of trade, but wild nutmeg and the feathers of the bird of Paradise are also marketed. There are no settlements of any size. Fak Fak, facing Ceram, is the most important; Merauke, on the south coast, has a small wharf. These have a few Malay, Chinese, and Arab traders. The eastern boundary follows the line 141° E., except where it deviates along the Fly river; by agreement the navigation of this river is free alike to British and Dutch subjects. The area is administratively under the Governor-General of the Dutch East Indies.

The Territory of Papua. Occupying the south-east of the island, this territory, administered since 1901 by the Commonwealth,[1] covers 90,540 square miles, of which 2754 square miles are islands, chief among which are the Louisiade group. The native population was estimated in 1923 at 275,000, that of the non-indigenous population as 1523, of whom some 10 per cent. were stated to be engaged in missionary work. The northern boundary does not reach the watershed of the mountains. In the south-west is the alluvial lowland round the Lower Fly; this river, with large deltaic islands at its mouth, feels the influence of the tide for 100 miles upstream. While soils (both volcanic and alluvial) and climate are eminently suited to tropical crops, the development has been slow. A good deal of the lowland has a dry season from May to November, but this would suit many crops, such as cotton, tobacco, and fibres. Nearly 200,000 acres of land are leased to planters,[2] and labour ordinances govern the recruitment of natives and their conditions of service; no long-term indentures are allowed. The Government is now encouraging free labour rather than contract labour, though this policy is sometimes criticized as tending to undermine tribal organization. Commercial plantations

[1] The transfer was not finally completed until 1906.

[2] Only the Government may buy land from the natives; it then leases it to planters.

are encouraged, while it is insisted that if the land be suitable each native must plant coconuts or some other crop of economic value. There is a poll-tax, the net proceeds of which are devoted to educational and welfare work.

Apart from native agriculture, there are some 300 plantations, mainly devoted to coconuts, but including also rubber

FIG. 154. COPRA-DRYING GROUND, PAPUA

A chief's house, with drying-ground in front. Note the typical Papuans, coconut-palms, and bananas.

Photo E.N.A.

and sisal hemp. The cultivation of kapok, coffee, cotton, cocoa, spices, and rice is little more than sufficient to demonstrate the possibility of their production. The economic forest resources are all but unexploited, while stock-rearing is of little significance. A number of luggers, chiefly from Queensland, engage in the pearl-fishing, while trochus-shell and *bêche-de-mer* both figure in the exports; these fisheries are associated with the reefs and cays that are found off the coast. Gold has been important, but alluvial deposits have been largely worked out; besides on the mainland, it is found

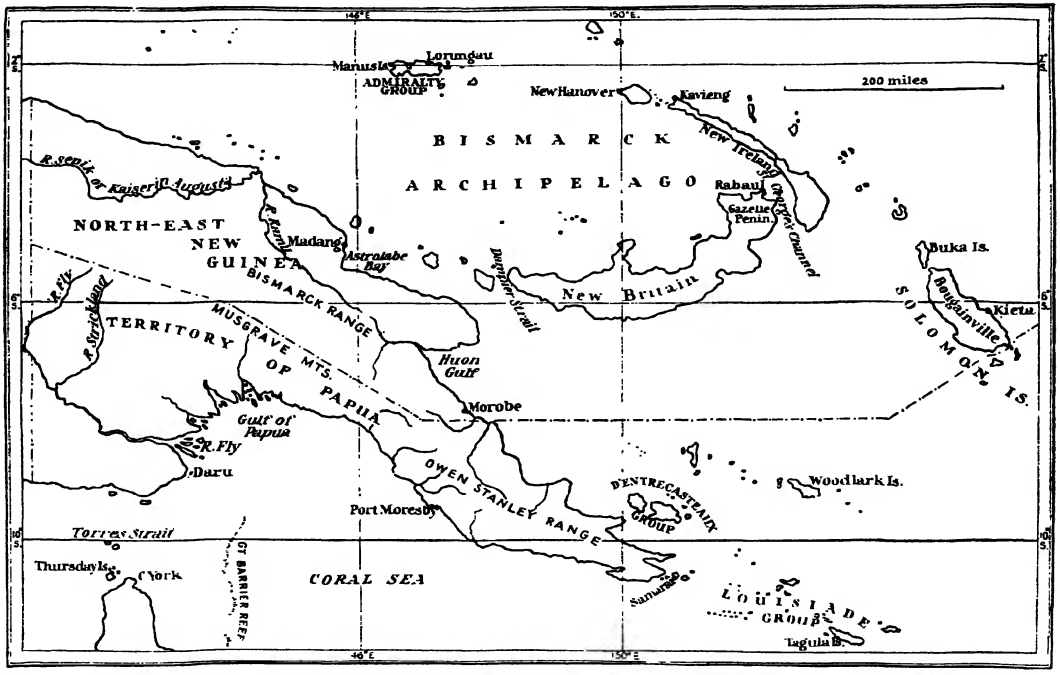

FIG. 155. EASTERN NEW GUINEA AND THE BISMARCK ARCHIPELAGO

This area is administered by the Commonwealth.

in the Louisdale and Woodlark Islands. Near Port Moresby a promising copper-field has been closed down owing to low prices. Osmiridium is sometimes found with gold, and other minerals, including coal, are known; oil-prospecting has not hitherto disclosed payable quantities. The large water-power resources are untouched.

The Louisiade group consists of more than eighty islands, generally bordered by coral reefs. They are forested. A little gold comes from Tagula, the largest of them.

Four ports of entry share the import trade; they are Port Moresby, Samarai, Woodlark Island, and Daru. Port Moresby, situated on a good harbour, in a somewhat dry and unproductive area, is the administrative headquarters, and has a monthly steamer service with Sydney. Daru is the chief centre for the pearl-fisheries. Coastal shipping services are important. Imports in 1927–28 amounted to £404,000, and were chiefly made up of miscellaneous foodstuffs and manufactured goods derived from Australia; exports were valued at £350,000, of which copra provided nearly £200,000, rubber £100,000, with much smaller values for *bêche-de-mer*, shell, and gold.

The Territory of New Guinea. This ex-German protectorate is administered by the Commonwealth Government under a Class C mandate from the League of Nations.[1] It comprises not only the north-east of the island (Kaiser Wilhelm's Land), but the Bismarck Archipelago and the western end of the Solomon group. The approximate total area is 91,000 square miles; in addition to an estimated native population of 460,000 there are some 1800 British, 1200 Chinese, and a number of Germans, Dutch, Americans, and Japanese. The Chinese are usually artisans or traders. Missionaries are active in both educational and planting work. In general

[1] The mandatory system has three categories: (1) Class A, where help is to be given by the mandatory until the territory can stand on its own feet —*e.g.*, Palestine, Syria; (2) Class B, where the mandatory is allowed to administer if she voluntarily accepts the responsibility of promoting the material and moral welfare of the indigenous people—*e.g.*, the Central African territories; (3) Class C, where for convenience the mandatory may administer the area under its own laws as an integral portion of its territories, with safeguards for the indigenous population. All the Pacific mandates belong to Class C.

the Australian administration is working hard to fulfil the obligation accepted under the mandate to fit the natives "to stand under the strenuous conditions of the modern world." In particular it is doing much to rehabilitate the physique of the native; it encourages anthropological work, and, although contract labour, chiefly engaged on ex-German freehold properties, is likely to remain for a long time, the Commonwealth is endeavouring to use the system to consolidate village life and to raise the standard of native agriculture.

North-east New Guinea. Including some adjacent islands, this covers about 68,500 square miles. The mountainous interior is still but little known, and the estimate of the population, 240,000, is somewhat conjectural. The coastline is partly fringed by reefs, and the rivers—the chief of which is the Sepik—though to some extent navigable, have marshy plains at their mouths which are unsuitable for settlement or for shipping. Development is confined to coastal districts, notably in the east, round Huon Gulf. The coastal population is largely Melanesian, that of the interior Papuan, and nearly 20,000 are indentured for work, principally on coconut plantations.

The productions are very similar to those of Papua, but the plantation development is more extensive and the gold-production much greater, particularly owing to the development of a small but useful field sixty miles inland, in the Morobe district; this is the Edie goldfield, situated at about 6500 feet. The other mineral wealth is just as varied and undeveloped. Madang (non-indigenous population, 270) and Morobe are the principal settlements.

The Bismarck Archipelago. This forms a crescent-shaped chain, cordilleran in character, and includes New Britain (Neu-Pommern) and New Ireland (Neu-Mecklenburg), as well as other islands, notably Lavongai (Neu-Hannover) and the Admiralty Islands. The main island of New Britain covers 10,000 out of a total of some 18,000 square miles, and contains considerably more than half of the total estimated population of 135,000. The whole area is sometimes referred to under the name by which it was known before the German

occupation, the New Britain Archipelago. The main islands (there are a number of 'low' islands) are mountainous, and largely volcanic. New Ireland—separated by the St George's Channel from New Britain—has no active volcanoes, but the latter possesses several, including one called the Father reaching 7500 feet. Though the islands are densely forested, a good many species characteristic of New Guinea seem to be absent, and the bird of Paradise is not found. The inhabitants are mainly Melanesian, with a few minor Micronesian colonies on the small islands east of New Ireland; apart from the better-known districts, "man is often wilder than nature."

The principal development is in the Gazelle Peninsula, at the extreme north of New Britain; after coconuts the principal plantings are coffee and cocoa, but these are of little significance. Attention is now being given to the cultivation of kapok. On New Ireland there is similar production round Kavieng. Native crops include sugar, tobacco, sago, and cassava, but these hardly enter into commerce. Copra again is the chief production of the Admiralty Islands (about 600 square miles, with 14,000 inhabitants), where Lorungau, on Manus, the largest of these, is a small settlement. The centre of administration is on the Gazelle Peninsula, Rabaul (non-native population, 1350), near which is Blanche Bay, the only place visited by oversea shipping.

The Mandated Solomon Islands. The Territory of New Guinea covers a portion of the Solomon Islands, including particularly Bougainville and Buka. The respective areas of these islands are approximately 3500 and 300 square miles; the former has 46,000 out of a total of about 56,000 inhabitants, of which the non-native element numbers only 150. Volcanic and mountainous (one dormant peak exceeds 10,000 feet, but only one active volcano is known), the islands have a hot and humid climate. The Melanesian population grows bananas, coconuts, and taro. Plantation work has only recently been taken up, and the commerce is small. The principal harbours are Kieta, on the eastern side of Bougainville, and Queen Carola Harbour, on Buka.

Communications and Trade. The whole area lacks any

large reserve of labour, and much of it is all but untouched by white influence. The terms of the mandate involve the encouragement of native agriculture; plantation development is therefore restricted; native production, however, is likely to increase only slowly. Some 20 per cent. of the copra export now comes from communal groves. The physical conditions are a hindrance to road and railway development, even if the administration were in a position to finance them. With scattered development, coastal and inter-island shipping is of great importance. A feature of the development of the New Guinea goldfield has been the use of aircraft for transport across mountain and forest.

In 1927–28 the total imports were valued at £812,000 and the total exports at £1,470,000. The bulk of the imports, consisting of many miscellaneous goods, were from Australia. Of the exports, copra was valued at £1,176,000, followed by gold (£256,000), shell (£23,500), and trepang (£11,000).

The British Solomon Islands

This has been a protectorate since 1893, and is physically continuous with the mandated islands referred to above. The whole Solomon group lies between 5° S. and 11° S., and consists of two parallel chains of a mountainous character, composed of volcanic rock, with coralline limestone round the coast, together with a number of smaller groups that are comprised within the archipelago. It seems to be rising steadily, and some of the smaller islands are of recent coral formation. Atolls and reefs are common. Of particular interest is Rennell Island, a raised atoll in the shape of a long, narrow dish, which has a rim with an average height of 400 to 500 feet and the interior lagoon 75 feet above sea-level. Much of the rim is of karst character, with caverns and sink-holes, while it plainly shows the origin of the phosphatic rock so important on certain Pacific islands—the leaching of bird guano into the limestone.

The total area of the protectorate is about 11,000 square miles. Of the larger islands Choiseul, Ysabel, and Malaita are in the northern chain, and New Georgia, Guadalcanar,

and Rauro (San Christoval) in the southern chain. Numerous *outlying islands are included, notably* the Santa Cruz or Queen Charlotte group, mainly volcanic, to the east and the Lord Howe group (Ongtong Java) to the north; the latter is really an atoll measuring 35 miles by 18 miles.[1] The native

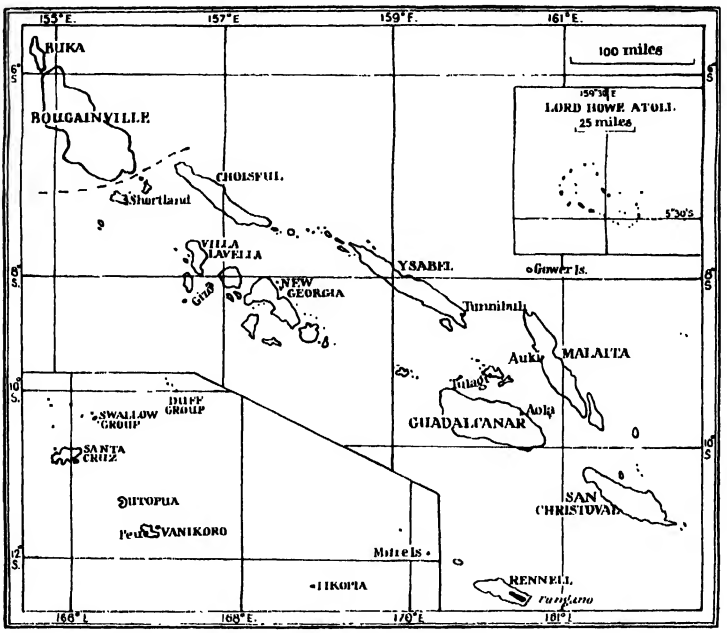

FIG. 156. THE SOLOMON ISLANDS

Note the raised atoll of Rennell, the lagoon of which is now Lake Tungano.

population, numbering 150,000, is mainly Melanesian, and suffers among other diseases from yaws, hookworm, malaria, measles, and pneumonia. There are about 500 Europeans and a few Asiatics.

In Guadalcanar Mount Lammas reaches 8000 feet, and on the larger islands there is little lowland; the northern coast of San Christoval possesses the largest stretch. The climate

[1] This should not be confused with Lord Howe Island, the dependency of New South Wales (see pp. 225 226).

is of the equatorial oceanic type, with a heavier rainfall when the north-west monsoon blows (from December to April) than when the south-east trades prevail. Mean monthly temperatures throughout the year are a degree or two above 80° F., and the highest elevations may have up to 200 inches of rain. Devastating hurricanes are unknown. The forests are but little worked, and it is of interest as showing an Australian type that the kauri pine occurs in the Santa Cruz group. Mangrove-swamps occur along parts of the coast, and these islands show the most easterly extension of the crocodile.

The soil is generally fertile, and much land has been cleared for coconut plantations; this is the principal interest, but bananas and pineapples are also cultivated. The native population supplies the labour, of which there is a scarcity. Malaita is the most populous island, and from it comes most of the plantation labour; some 6000 workers are employed. The forests yield ivory-nuts and a little timber, and trochus-shell and *bêche-de-mer* are collected.

There are only paths and tracks—no roads and no railways, nor any cable or telegraph system. Coastal traffic is very important, and a six weeks' service is maintained with Australia. The administrative centre is Tulagi. In 1927-28 imports—mainly miscellaneous goods, including foodstuffs, drapery, bags and sacks, and tobacco from Australia—were valued at £300,000 and exports at £430,000; the latter included copra (£390,000), trochus-shell, ivory-nuts, and a little timber.

The New Hebrides

Continuing the line of the Solomon Islands, this group, which also shows a double chain, runs north-north-west to south-south-east, for 550 miles. Some eighty islands, high and low, are included, with a total area of 5700 square miles; Espiritu Santo, in the north, is the largest, 1500 square miles in area. The high islands are volcanic, and are marked by raised coral terraces found as high as 2000 feet; several active volcanoes are found among the smaller islands, and there was a violent eruption on Ambrym in 1929. The

maximum elevation is 6169 feet. The islands are under the joint control of the British and French; there are safeguards for both groups of nationals, as well as for the natives. In practice the administration is not very satisfactory. The native population is predominantly Melanesian, and during the nineteenth century provided much of the Kanaka labour for Queensland and elsewhere; it now numbers about 50,000; there are about 1000 whites (nearly four French to one British), and of some 5500 Asiatics all but a few have opted for the French *régime*; these include more than 5000 Tonkinese, imported as labourers on plantations of French ownership. The natives suffer considerably from a number of diseases; as each usually possesses a small coconut plantation, the local labour-supply is limited, although some are employed under contract. Educational work among them is confined to missionaries.

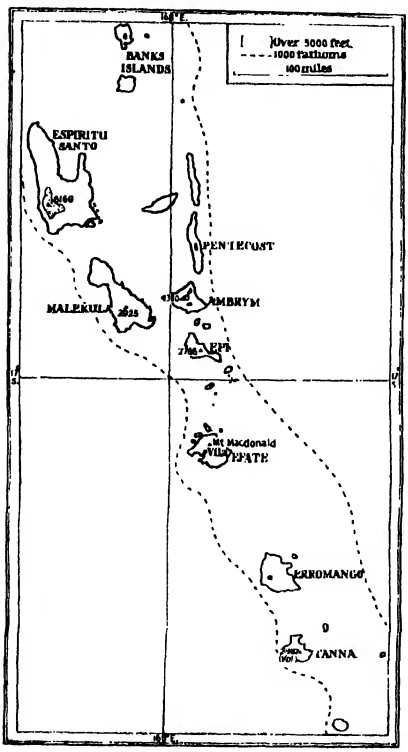

FIG. 157. THE NEW

The climate is enervating for Europeans; the islands lie mainly between 14° S. and 20° S., and have temperature and rainfall conditions similar to those of the Solomons; hurricanes are occasionally experienced. They are heavily forested, and on one island kauri pine—formerly worked—is found; some sandalwood is obtained. The fisheries include

bêche-de-mer, pearl shell, and tortoiseshell. There is little evidence of mineral wealth. The livestock includes a fair number of sheep.

Some 40,000 acres are under cultivation, the bulk being in French hands, as the French have the advantage of Tonkinese labour. The soil is generally fertile, and while the greater part of the acreage is under coconuts, the French planters are paying considerable attention to cocoa, cotton, and coffee. Sugar and tropical fruits are also cultivated, as well as maize and vanilla.

There are few good roads, and as oversea trade concentrates on Vila (on the island of Efate) the coasting trade is considerable. Most of the oversea and coasting trade is done in French ships. The principal export is copra, of which only a small proportion is grown by the natives. Imports in 1928 were valued at £375,000, and included a variety of provisions and manufactured goods, largely sent from Sydney, and wines and spirits from France. Exports reached nearly £400,000, and included copra (£210,000), cocoa (£80,000), cotton (£44,000), and smaller amounts of coffee, trochus-shell, maize, sandalwood, and wool. The British share of the total trade is about 25 per cent.

New Caledonia and the Loyalty Islands

The Loyalty Islands, the Isle of Pines, and a number of smaller groups are dependencies of New Caledonia. The islands are French, annexed in 1853 following chaotic conditions connected with trading, exploitation, and missionary activity. New Caledonia was for long used as a penal colony, which hindered development. The convict element is declining, for transportation ceased about 1900, and it seems that the rapid diminution of the native population has been stayed. New Caledonia itself, a high island lying between 20° S. and the Tropic of Capricorn, allows European acclimatization relatively easily. Central New Caledonia is mountainous and reaches 5415 feet. The Loyalty Islands are recently elevated coral islands, with a maximum height of 250 feet.

New Caledonia is 248 miles long, and covers, with the Loyalty Islands, 8548 square miles. The total population numbers about 52,000, of whom half are natives (Melanesian, with a small Polynesian admixture) and 17,000 (including the convict element) are whites. New Caledonia itself is characterized by deep valleys, torrential rivers, and small

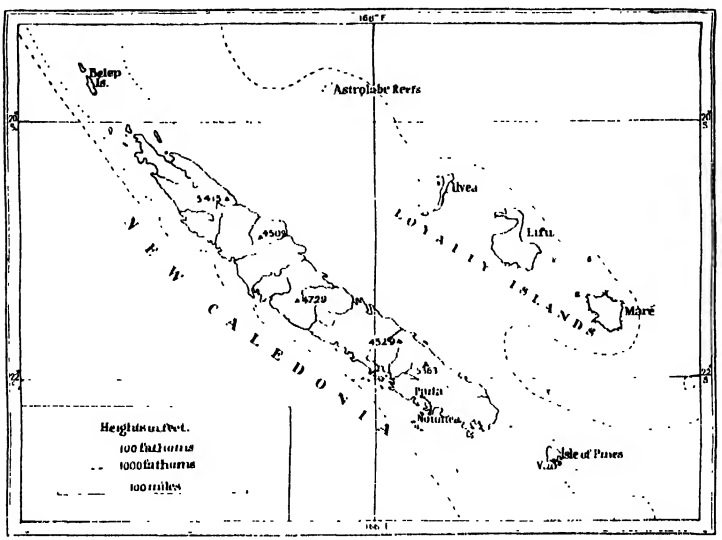

FIG. 158. NEW CALEDONIA

The Loyalty Islands are low. Note the steep rise of the submarine ridge and the short length of railway.

deltaic plains, while a great barrier reef lies off the west and east coasts. The climate is cooler and healthier than that of the New Hebrides; no month is absolutely rainless, but the hot season is the wet season. Dense forests cover only a limited area, and a large proportion is grassland or bush country. Half the area is mountainous or waste land. The flora contains both Polynesian and Australasian elements; the Isle of Pines obtained its name from the araucaria, which is common there; it formerly yielded sandalwood.

The principal cultivation is coffee, but copra, cotton, cassava, sugar, bananas, pineapples, vanilla, tobacco, and

maize all receive attention, while the pastoral land is occupied by 200,000 cattle and 25,000 sheep. But the special interest of the island is in its mineral wealth. Archæan rocks are extensively developed in the north-east, and ancient eruptive rocks, largely serpentine, cover two-thirds of the island. These have a rich mineral content. The principal metal formerly worked was nickel (specially valuable because

FIG. 159. NEW CALEDONIA: CONVICTS WORKING IN THE NICKEL-MINES

Photo F.N.A.

free from arsenic), but more recently chrome ore has become important. These, with iron and cobalt, are found in the igneous rocks, while copper and gold are found in the Archæan areas. Other known minerals include lead, antimony, cinnabar, and manganese. Two reducing furnaces, as well as power from a hydro-electric undertaking, deal with the nickel. Other local industries include meatworks and mills for dealing with coffee and cotton.

There are few good roads, though a motor-road service runs from Noumea to Bourail. A twenty-mile single-line, narrow-gauge railway runs from the former place to Paita;

it is proposed to continue it to Bourail. Noumea (population, 10,000) was founded in 1854 under the name of Port de France; it lies toward the south of the west coast, and, with an excellent harbour, concentrates the oversea trade; it has the advantage of regular connexion with Sydney. Imports in 1928 (at 120 francs to the pound sterling) were valued at £1,250,000; they included wine, coal, flax, and rice; exports reached £800,000, and principally consisted of nickel, chrome ore, phosphates (coming chiefly from some small dependencies lying beyond the Loyalty Islands), copra, and coffee.

The **Loyalty Islands**, composed of coral, lie to the north-east; they number nearly sixty, and have a total area of about 800 square miles, the bulk of which is comprised in the three large islands of Maré, Lifu, and Uvea. Lifu is the largest of these; Maré is of interest in showing three stages of elevation; Uvea is an atoll. Copra is the leading product.

Other dependencies include the Wallis Archipelago, north-east of Fiji. Covering only 40 square miles, this group has 4500 inhabitants. A good deal of copra is produced for export.

Fiji

This important group shows the most easterly extension of Melanesia. It lies between latitude 15° S. and 22° S. and longitudes 178° W. and 177° E., so that the 180th meridian passes through the group. The time question is settled by a local enactment putting the whole group into east longitude for the purpose, the legal time being twelve hours in advance of Greenwich. It is stated that the 'bent meridian' was introduced because a planter on one of the islands tried to evade the prohibition of Sunday labour by working his men on one side of the meridian 180° on one day and on the other the next. The incidents which led to the British annexation have been referred to earlier in this chapter. The Governor of Fiji is also the High Commissioner for the Western Pacific, with jurisdiction over all the islands that are specifically British.

The 250 islands of the group are scattered roughly in a

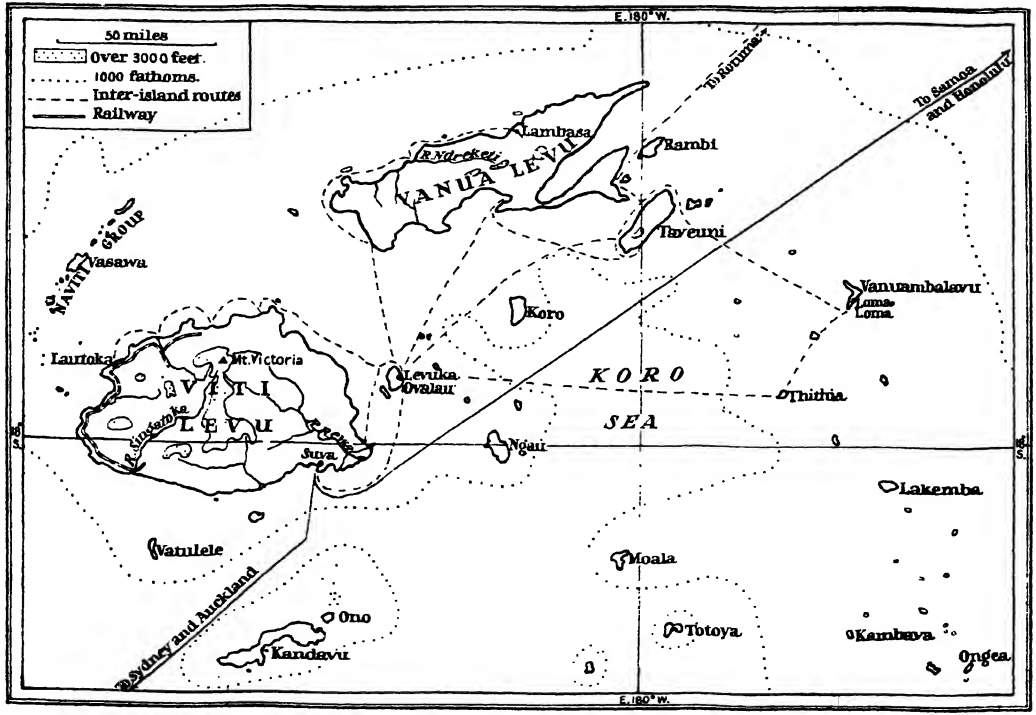

FIG. 160. THE FIJI ISLANDS

ring enclosing the Koro Sea. The eastern islands are small, and the greater part of the area of 7083 square miles is comprised in Viti Levu (4053 square miles) and Vanua Levu (2130 square miles). Other considerable islands are Kandavu and Taveuni, while the group also includes Rotuma, lying some distance to the north. Only about eighty islands are inhabited. The native population is Melanesian, but includes a notable Polynesian element; it is much smaller than formerly; apart from other contributory causes, a third of the inhabitants died from an epidemic of measles in 1875. Shortage of indigenous labour (see p. 370) led to the introduction of Indians, who now dominate the commercial production. At the beginning of 1929, out of an estimated population of 176,793, there were 91,028 Fijians, 73,966 Indians, 4569 Europeans, and 1352 Chinese; the island of Rotuma—small and densely populated—had 2260 natives. The Fijians are now increasing, but at a less rapid rate than the other elements in the population. Influenza, pneumonia, and tuberculosis are added to the diseases common to tropical islands in the Pacific, and there is a leper segregation on Makongai.

The islands, except for a few atolls, are essentially volcanic, and contain much tuff interstratified with Tertiary limestone and all resting on limestone. An interesting feature is the existence of a granitic plateau believed to be a horst —in the south of Viti Levu; this is known to contain various minerals, including gold and graphite. There are hot springs north of Suva and on Vanua Levu, while earthquakes sometimes cause destructive waves. Professor W. M. Davis has pointed out, as tending to support Darwin's view of reef-formation, that on the south-west of Viti Levu and the south of Vanua Levu there are raised reefs and fringing reefs, but no barrier reefs offshore, while on the north and north-west of Viti Levu there are offshore barrier reefs, but no raised reefs. The volcanic islands are mountainous, and Mount Victoria, on Viti Levu, reaches 4500 feet, while 4000 feet is also exceeded on Taveuni. Heavy rainfall has led to the development of very fine scenery, and numerous rivers, utilized for irrigating deltaic areas, are found, notably the

Rewa and Singatoka, on Viti Levu, and the Ndreketi, on Vanua Levu.

Mean monthly temperatures range from 74° F. to 82° F., and no place has a mean rainfall below 64 inches. That of Suva is 117 inches. The main islands lie athwart the south-east trades; the rainfall is heaviest from November to April, brought plentifully by the prevailing winds, especially to

FIG. 161. CUTTING SUGAR-CANE FIJI
Note the Indian workers.
Photo I.N.A.

the windward side of the islands; hurricanes occur occasionally in summer. The hills show temperatures modified by altitude, and have a greater rainfall; the atolls, however, show relatively small rainfall. Dense jungle covers the exposed sides of the mountains, but sheltered lowlands are grass-covered, and largely utilized for cultivation and cattle-rearing. The coconut is characteristic of the coastal districts, and many coastal mangrove-swamps have been reclaimed for sugar-cultivation. Sandalwood, once an important production, has now to be protected.

The volcanic soil is very rich, as also is the deltaic land. Especially notable is the Rewa plain—the largest in Fiji—

and the plain of the Ndreketi. The physical conditions favour intensive development; this is mainly in the hands of Indians. These are now a body of small farmers responsible for most of the sugar and practically all the rice, maize, and cotton that are grown. They are also traders and storekeepers, notably in Suva, and only a few are available for contract labour. While the Fijians live in small towns and villages, the Indians have their own settlements; there is no intermarriage. The Fijians own almost all the forest land, and are essentially agriculturists; they grow yams, taro, manioc, sweet potatoes, plantains, and breadfruit for food with rather primitive implements, most of the coconuts and bananas produced being for profit; they are now taking up sugar-cane, but this development is hindered by the present low price of sugar. There are a good many company plantations, and rubber-growing has been attempted, while a beginning has been made with pineapples in one or two areas. The maize and rice are grown for local consumption, and the development of crops other than sugar is being encouraged because of the danger of too much dependence upon this dominant production.

The importance of Government supervision and research is well illustrated in the case of copra. The Government supervises the coconut plantations, and has been responsible for introducing a fly parasitic upon the purple moth that a few years ago was devastating them. Scale insect—another fruitful source of trouble—is being brought under control with the assistance of an introduced ladybird. The administration controls the export quality of the bananas, and has a cotton research station on the Singatoka river; the attempt is being made to revive this industry on the basis of a New Guinea variety.

The cattle industry is of growing importance; there are some 55,000 cattle, and while these are mostly beef cattle, a recent development has been the growth of a dairying industry, so that the islands are now self-supporting in butter. Cattle are used as weeders on coconut estates, also for draught purposes, while there are 11,500 horses, donkeys, and mules. Trochus-shell is collected. Although mineral

veins are known, they are not found in commercially exploitable quantities.

Under the principal crops there were in 1928 the following areas: coconuts, 114,000 acres; sugar, 38,000 acres; rice, 12,000 acres; and bananas, 2700 acres. Industry was represented by a number of mills and factories devoted to sugar, rice, copra, butter, and other products, while a meat factory is a recent innovation. Tourist traffic has growing importance.

Native opinion is expressed through a Great Council of Chiefs, and education is compulsory, though there is generally only a choice of subsidized denominational schools. The better-educated Fijians often fill administrative and clerical posts, and some are doctors and magistrates. The Government is paternal in character.

Suva (population, about 13,000, including 1750 Europeans), on the south-east of Viti Levu, is the capital, and possesses a good harbour. It is the port for oversea shipping, and is in direct cable communication with Canada, Australia, and New Zealand. There are regular steamer services to Sydney and Vancouver, calling at Auckland and Honolulu, and *via* Samoa to San Francisco. Levuka, on the east of Ovalau, was the former capital, and Lautoka, on the north-west of Viti Levu, is of growing importance. Of nearly 2000 miles of roads, 350 miles are available for all-weather motor-transport. There is a private narrow-gauge railway along the west coast of Viti Levu.

Imports in 1928 were valued at £1,483,169 (£1,223,303 in 1927) and exports at £2,701,251 (£1,997,374 in 1927). The year 1928 was a prosperous one, and the recent fall in the price of sugar has been keenly felt. Imports were chiefly foodstuffs, textiles, hardware, machinery, oil, timber, and coal; foodstuffs came chiefly from Australia and New Zealand, general imports from the United Kingdom, oil and hardware from the United States, and fish, motor-cars, and timber from Canada, while Japan sent cheap cotton goods. Australia is the chief supplier of imports. Among the exports sugar led at £1,827,000, much being sent to Canada; copra, sent largely to Australia, the United Kingdom, and Europe,

was next, at £567,000; and bananas, exported chiefly to New Zealand, ranked third, at £148,000.

Micronesia

Mainly north of the equator and west of longitude 180° are many small islands (hence the name), the size of which is perhaps due to the greater or more rapid subsidence of the Northern Pacific. Only in the Mariana or Ladrone Archipelago are volcanic rocks found; the remaining islands, principally the Caroline, Marshall, Gilbert, and Ellice groups, though scattered over a large area, are atolls. The Micronesian population contains different elements, and Malay, Mongol, Melanesian, and Polynesian characteristics are to be distinguished in different parts of the wide area. This gives rise to different shades of skin colour, but generally complexions are dark and stature short in comparison with those found in Polynesia. The Micronesian language, like that of Melanesia, but unlike that of Polynesia, shows a large variety of distinctive dialects; its main relationships are Polynesian, but there are also Malay affinities.

The Ladrones, Carolines, and Marshalls are administered under mandate by Japan, though in the first group the United States possesses the naval and cable station of Guam. Here particular attention will be directed only to the Gilbert and Ellice groups and one or two islands which lie immediately adjacent to or south of the equator.

Gilbert and Ellice Islands

These, after a chequered history connected with trading, kidnapping, and disease, became a protectorate in 1892. They lie between 172° E. and 180° longitude; the equator cuts the Gilbert group, and the Ellice Islands are a few degrees south; together they form a chain 800 miles long. The colony, which is under the High Commissioner of the Western Pacific, now includes Ocean Island, the administrative headquarters, and three small Polynesian islands far to the east—Washington, Fanning, and Christmas Islands.

Fanning Island is the most important of the three, being a cable station and producing copra. Christmas Island is the largest atoll in the Pacific.

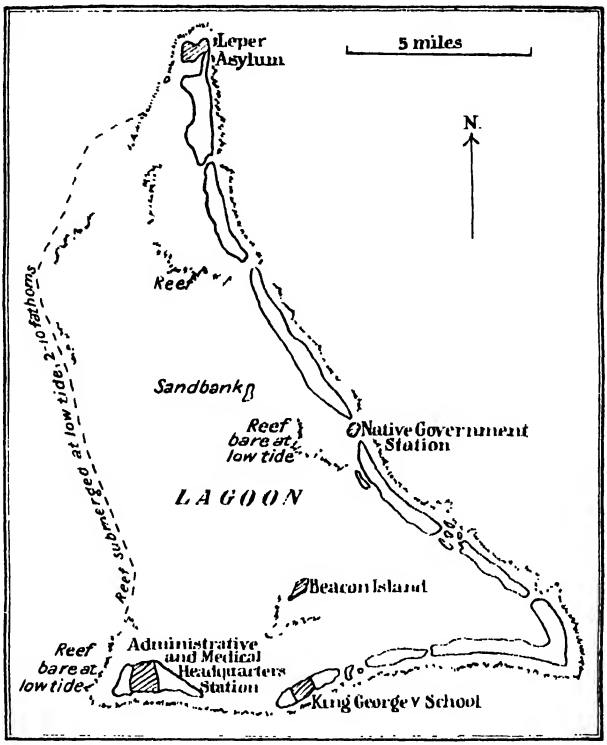

FIG. 162. TARAWA ISLAND—GILBERT GROUP

This is the chief centre of the group, and is a typical atoll lying a few degrees south of the equator.

Based on a map in a Colonial Office Report

The Gilbert Islands number sixteen and the Ellice Islands nine; they are all atolls, 5 to 50 miles long, and no islet reaches 15 feet above sea-level or exceeds 5 furlongs in length. The total area is barely 180 square miles. Despite a heavy rainfall, there are no rivers. The islands have an oceanic climate, with pleasant and bracing north-east trades from

March to October and rain and tropical gales for the rest of the year. The rainfall is very variable; the annual average exceeds 100 inches, but as little as 3 inches has been known on some islands. Ocean Island (lying a little south of the equator, to the west of the Gilberts) had barely 13 inches in the year 1924–25 and 128 inches in the following year. The total native population (which on the Ellice group is Polynesian in character) is 30,000, and is little more than stationary. Tuberculosis, attributed to the adoption of European dress, is common. There are 230 Europeans and 640 Asiatics, of whom 120 Europeans and 601 Asiatics are on Ocean Island alone.

The soil is sandy, poor, and porous, water having to be conserved in tanks; the coconut plantations are entirely in the hands of the natives, and yield small and inferior copra; efforts are being made to improve the quality. The natives laboriously cultivate babai, a coarse edible tuber, for food. Much more important commercially are the phosphate deposits of Ocean Island, which, worked by Gilbertese and Chinese labour, are very productive. Apart from storage in refrigerators at Ocean and Fanning Islands, no fresh milk, butter, meat, fruit, or vegetables are available locally. Tarawa is the distributing centre of the Gilberts and Funafuti of the Ellice group. Imports (chiefly provisions, apparel, and hardware) were valued in 1928 at £150,000 and exports at £313,000; more than three-quarters of the latter were phosphates and the rest copra.

Nauru or Pleasant Island

Nauru lies west of Ocean Island, and is an oval-shaped atoll 12 miles in circumference, with an area of 8 square miles. The population totals 2614, and consists mainly of Nauruans and Chinese, with 134 Europeans. A belt of fertile land planted with coconuts rises to a low plateau, which overlooks an almost fresh-water lagoon. The low plateau has the rich phosphate deposits which yield, together with a little copra, the exports of the island. Formerly German, it is now administered as a British Empire mandate, shared by Great

Britain, Australia, and New Zealand. Phosphate-production is vested in a Commission, and the three Governments may share the output according to their respective requirements. In recent years some 70 per cent. has gone to Australia, and almost all the rest to New Zealand. A proportion of the royalty paid on the phosphate-production is earmarked for the benefit of the indigenous population. Imports in 1928, chiefly foodstuffs and machinery, reached £240,000; this was greatly in excess of previous years, owing to the importation of new plant; exports were valued at £320,000.

Polynesia

This division covers a very large area, and includes as its principal chains the Hawaiian or Sandwich Islands and the Tuamotu or Low Archipelago; other important groups are the Tonga (Friendly), Samoan, Tokelau (Union), Phœnix, Cook, Society, and Marquesas Islands. They include both high and low islands, the Tuamotu Archipelago being noteworthy among the latter. The Polynesians, happy and light-hearted in temperament, are distinguished by their light skins and tall and handsome physique. The stability of their language is illustrated by the fact that Maoris and Hawaiian islanders have been able to understand each other. Characteristic native cultivation includes, apart from coconuts, breadfruit, taro, and yams, while from a pepper-like root kava, an intoxicating drink to which the Polynesians are addicted, is made. Politically the United States control Hawaii and Eastern Samoa; France possesses the Marquesas, Tuamotu, Society, and Austral groups; New Zealand administers the Cook and Tokelau groups and (under mandate) Western Samoa; the rest of Polynesia is almost entirely British. Here only Southern Polynesia will be considered.

The Tonga or Friendly Islands

This group, originally discovered by Tasman, has been a British protectorate since 1900; it lies in west longitude, east-south-east of Fiji, on the submarine ridge that carries

the Kermadec Islands and New Zealand. Although it is in west longitude, Fijian time is kept. There are four main groups, and most of the islands are of coral formation, although in the west is a chain of small volcanic islands, some of considerable elevation. Several have been active in recent years, and of particular interest is Falcon Island, which has appeared and disappeared several times since 1865, when it was found to be 153 feet above sea-level and composed of lava, volcanic ash, and cinders. By 1894 it was all washed away, but it has been an island on and off several times since. Another island of interest is Niuafo'ou, the crater of a dormant volcano; almost circular in shape, it is about 9 miles in circumference; the ring of land, which rises to between 300 and 600 feet, encloses a lake the surface of which is 95 feet above sea-level. The largest island is Tongatabu—of coral—covering 125 square miles out of a total area of 390 square miles. The larger islands rise to several hundred feet, and are undulating in character. Mean monthly temperatures vary from 72° F. to 80° F. South-easterly winds prevail from May to October, which period is relatively cool and dry; violent winds from the opposite quarter occur early in the year, when it is hot and moist. The annual rainfall varies from 60 to 100 inches.

The native population of 27,000, chiefly on the large islands, is increasing; there are some 600 Europeans. The natives, nearly all connected with some Christian Church, produce much copra for export, in addition to yams, bananas, and arrowroot for local consumption. The administrative centre is Nukualofa. Imports in 1928 amounted to £212,000, and included miscellaneous foodstuffs and other goods; exports, practically all copra, reached nearly £290,000.

To the north of the Tonga group lies the **Tokelau** or **Union** group, and farther north still, a degree or two south of the equator, the **Phœnix Islands.** The latter group comes within the jurisdiction of the High Commissioner of the Western Pacific; it consists of eight small coral islands, covering 16 square miles and carrying a population of 60 imported labourers, who work on coconut plantations. They lie on the Great Circle routes Sydney to San Francisco and Fiji

to Hawaii. The Tokelau group was handed to New Zealand in 1896, and is administered from Samoa. It consists of three groups of coral islands, covering 4 square miles, with about 1000 natives producing copra.

The Samoan or Navigator Islands

This group, stretched out from west to east, consists of nine islands (with a number of mere islets), only two being

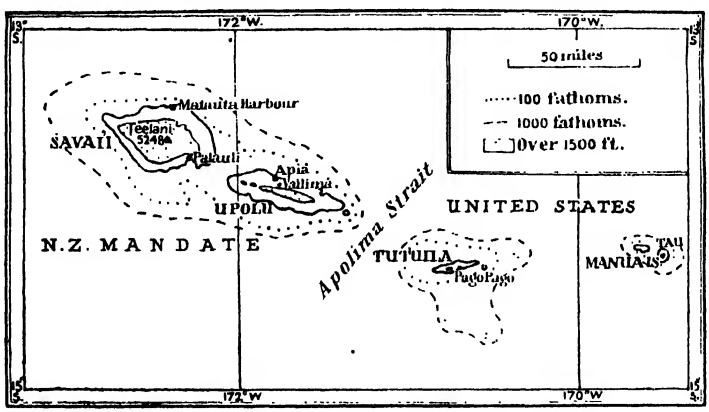

FIG. 103. THE SAMOAN ISLANDS

of considerable size. They lie in about 170° W. longitude and 14° S. latitude. After tribal quarrels the intervention of Britain, Germany, and the United States resulted about 1878 in each obtaining privileges; by agreement in 1889 these Powers guaranteed the neutrality and independence of the islands. Further native troubles led to another agreement in 1899 1900, by which Britain waived her claims and left the bulk of the group to Germany, while Tutuila and other small islands of Eastern Samoa went to the United States. Following the Great War, Western Samoa was assigned under mandate to New Zealand.

With one exception the islands are volcanic, and the larger ones lofty, with barrier reefs. Slightly nearer the equator than Fiji, they have a similar climate, receiving much rain

from the prevailing south-east trades. Pago Pago has a mean annual rainfall of nearly 200 inches. Hurricanes may do considerable damage. The total area is about 1600 square miles, and the total population about 53,000.

The Territory of Western Samoa. This covers four islands, including the largest ones, and a number of islets. Savai'i has an area of 703 square miles, and rises to over 4000 feet; Upolu is less mountainous and more productive; its area is 430 square miles. The population numbers nearly 44,000, mostly Samoans, who are now gradually increasing; there are also 2800 Europeans and half-castes, and rather more than 1000 indentured labourers, chiefly Chinese. The Polynesian population, charming, light-hearted, and temperamental, has set New Zealand a difficult problem in this her most serious attempt at what is known as 'colonial government.' The mandatory, which subsidizes the local revenue, in carrying out the obligations of Article 22 of the Versailles Treaty, with perhaps some lack of appreciation of the psychology of the people, recently met with stubborn passive resistance on the part of many Samoans, who actually organized their own taxation, while refusing that due to the Government. The difficulties seem to have been caused by inexperienced administrators and a desire to carry out the terms of the mandate with too little preparation.

Most of the land is left to the natives, but an area of some 35,000 acres is in company or private hands and in part developed, while some 5000 acres of mission holdings are also partly planted. The principal product is copra; the Samoans work a very large acreage of coconut plantations, bananas and taro being their other chief interests. With indentured labour on plantations, copra is again the chief product, but there is a substantial area under cocoa—sometimes planted with rubber—and a small but increasing amount under bananas. A few acres are experimentally under cotton. Apia, on Upolu, is the port for oversea trade; regular communication is maintained with New Zealand. The imports, of a miscellaneous character, amounted in 1928 to £327,000, New Zealand being the leading supplier; exports reached £422,000, of which copra, sent mainly to the United

Kingdom and Western Europe, accounted for £320,000, cocoa for £70,000, and rubber for a smaller amount.

American Samoa. Two-thirds of the total area of 60 square miles is occupied by Tutuila, which contains rather more than two-thirds of the total population of 8800. Copra is the leading economic interest, and provides the only export, although taro, breadfruit, yams, pineapples, oranges, and bananas are produced. Pago Pago, on the south of Tutuila, in a cleft flanked by wooded volcanic crags, is not only one of the most beautiful harbours in the world, but the best port of Samoa, a naval station, and an important port of call for vessels on the Fiji-Honolulu route between Australia and Western North American ports. (See Fig. 11.)

The Cook Islands

This group, lying in the longitude of Hawaii, about 20° S. latitude, has been a dependency of New Zealand since 1901, when it was handed over by the British Government. It includes for administrative purposes Niue or Savage Island (which is actually nearer the Tonga group), as well as Manihiki and Suwarrow—the latter uninhabited—lying to the north of the main group. Containing thirteen inhabited islands, mostly atolls, the group covers a total area of about 280 square miles, with a population of about 14,300. Rarotonga and Mangaia are both of volcanic formation, the former rising to 2100 feet and having abundant rainfall and vegetation. Niue, carrying, like Rarotonga, nearly 4000 inhabitants, is an atoll. The island of Palmerston is of interest as having been sighted by Magellan.

Production is concerned largely with copra, but fruit-growing, especially for the New Zealand market, has made considerable strides, and the leading export is now oranges, while bananas and tomatoes are extensively grown; other citrus fruits do well, and coffee is met with in Rarotonga. Coffee is also grown experimentally in Niue. Pearl shell is important in some islands, notably Manihiki and Tongareva (Penrhyn), the latter lying 300 miles north-east of the former. Educational work both in Government institutions and in

subsidized mission schools is well developed, and the export trade in fruit is supervised by Government inspectors. A feature of interest is the export of woven hats and basket-ware from Niue.

Most of the trade is with New Zealand. Imports in 1928 were valued at £136,000; exports, which reached £154,000, included oranges (£58,000), copra (£44,500), bananas (£26,000), and tomatoes (£17,600).

North-east of Manihiki are a number of small British islands of coral formation; they lie within a few degrees of the equator, and include **Starbuck Island** (uninhabited) and **Malden Island.** The latter, covering 35 square miles, possesses a considerable deposit of phosphates.

French Establishments in Oceania

Scattered over a large area in the Southern Pacific, and roughly centring on 15° S. and 140° W., are a number of groups predominantly French; they have mostly been French since 1842. The most northerly is the Marquesas group, south of which stretches the Tuamotu or Low Archipelago, consisting of some eighty coral islands; the other groups are essentially volcanic. The high islands are generally fertile, well-watered, and forested; copra and mother-of-pearl are typical products of both these and the low islands. The high islands especially are susceptible of much greater tropical development, but lack of labour is a serious difficulty. The total area is estimated at 1520 square miles, and the population at 36,000, of whom a third are in Tahiti. The indigenous population numbers 30,000, while there are about 1100 Europeans (mostly French), 4000 Chinese, and a few Annamese.

The Marquesas Group. These volcanic islands, rugged and mountainous, cover 490 square miles, and possess only 2250 inhabitants. Few groups in the Pacific show such a decline in numbers and such degeneration in moral as does this. Copra, a little cotton, and a fungus cultivated for the Chinese market constitute the chief economic interests. Nuka-hiva is the largest island.

The Tuamotu Archipelago. These eighty coral islands and adjacent islets, totalling 330 square miles in area, run in two parallel lines from north-north-west to south-south-east. The population somewhat exceeds 4000, and is chiefly engaged in producing copra and collecting pearl shell. Phosphates are extensively worked on Makatea, an island with more than 1000 inhabitants. The atoll of Anaa is another populous island.

South-east of the Marquesas are the elevated **Gambier**

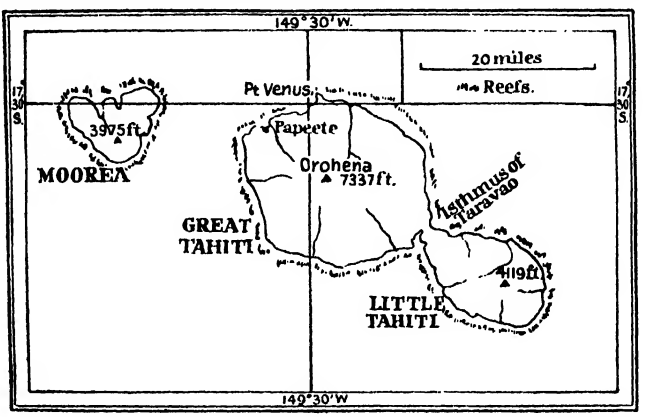

FIG. 164. TAHITI

Islands, covering a few square miles, with some 500 inhabitants, engaged particularly in the pearl shell industry.

The **Austral Archipelago** includes the Tubuai Islands, volcanic and fertile in character, with the Rapa group to the south; rather more than 100 square miles in total area, they carry some 4000 inhabitants, chiefly occupied in cultivation.

The **Society Islands** comprise Les Iles du Vent (the Windward group), containing Tahiti (440 square miles, 11,750 inhabitants) and Moorea (150 square miles, 1850 inhabitants), and Les Iles sous le Vent (Leeward group), a number of smaller islands, with 8500 inhabitants. The islands are volcanic and mountainous, surrounded by coral reefs, and with a considerable rainfall, some brought by violent hurricanes; they are picturesque and well forested. The largest and most

populous is Tahiti, from which Captain Cook observed the transit of Venus in 1769. This island consists of two mountainous peninsulas—the larger reaching nearly 7500 feet and the smaller a height exceeding 4000 feet—joined by a narrow isthmus. Spurs enclose fertile valleys and small plains. The principal development is round Papeete (5600 inhabitants), which is situated on the sheltered north-west coast, and has become one of the main centres of Pacific Ocean traffic and trade. Copra is the chief product, but sugar-cane is important, and bananas, oranges, and other fruits are cultivated. The climate is suited to cocoa, coffee, cotton, and other crops, of which, however, there is little development. The production of vanilla has declined in recent years in competition with that from Madagascar and the Comoro Islands. Pearl shell is collected, and there are a few factories devoted to sugar-refining and rum-distilling.

Communications and Trade. Oversea trade centres on Papeete, which has regular communication with Australia, New Zealand, and San Francisco. Inter-island shipping is necessarily important. Imports, chiefly textiles, foodstuffs, and hardware, were valued in 1928 at £400,000; exports, consisting chiefly of copra, phosphates, pearl shell, and vanilla, reached £350,000.

Pitcairn Island

This British island, 25° S. and 130° W., lying south-east of the Low Archipelago, has a certain historical interest. Discovered in 1767, some *Bounty* mutineers and their Tahitian wives occupied it in 1789. They were removed, owing to over-population, to Norfolk Island in 1856, but a number returned a few years later. The island is rocky, but fertile; it covers 20 square miles, and has about 140 people. A variety of crops is grown, including yams, sweet potatoes, oranges, bananas, and arrowroot, while goats and poultry are kept. The inhabitants are Seventh Day Adventists, converted in the eighties. Communication with ships is established by canoe from Bounty Bay, one of the two possible landing-places for boats. The island lies on the route of steamers between Europe and New Zealand *via* the Panama Canal.

CHAPTER X

ANTARCTICA

By R. N. Rudmose Brown

Exploration

The idea of an Antarctic continent was first suggested by the ancient Greek astronomers. They believed that the known world in the Northern Hemisphere must be balanced by another world, Alter Orbis, in the Southern Hemisphere. In the Dark Ages the problem of the Antarctic lay unattacked, but it began to exercise men's minds in the Age of Discovery in the sixteenth century and onward. Magellan in 1520 believed that he had found it in what is now known to be the island of Tierra del Fuego. Various other lands were at times thought to be the southern continent, till each in turn was found to be an island—New Guinea, the New Hebrides, Australia, and New Zealand. At length, in 1772, James Cook was sent by the British Government to seek for the southern continent and if possible to open up trade relations with its inhabitants. He found no land in the Far South after an exhaustive search, but proved that if a continent existed there, it was in all probability uninhabitable on account of the severity of the climate.

Early in the nineteenth century sealers pushing southward of South America discovered many island groups on the fringe of the Antarctic, and in 1830 Biscoe sighted what is now known to be the mainland of Antarctica, in Enderby Land, south of the Indian Ocean. Exploration of Antarctic regions made slow progress until the end of the nineteenth century, for there was small hope of commercial gain. Gradually, however, the importance of scientific investigation in high latitudes was realized, and the twentieth century saw a great outburst of exploring activity on the part of

various nations of Europe. Among the great discoverers of that period were Borchgrevink, Gerlache, Scott, Bruce, Nordenskjöld, Drygalski, Shackleton, Mawson, Amundsen, and Charcot. A great deal of discovery still remains to be made. The attainment of the South Pole by Amundsen in 1911, by Scott in 1912, and by Byrd (by aeroplane) in 1929 marked valuable journeys of exploration, but in no way ended the tasks of the explorer.

Physical Features

Exploration has established the existence of a huge continent in high latitudes, placed asymmetrically round the South Pole. The area of the continent is over 5,000,000 square miles, or considerably larger than Europe and nearly twice the area of the United States of America. Only about half the coastline of the continent has been seen, but from the evidence of the rocks the land is supposed to be continuous.

Nearly the whole of the continent is covered by a vast sheet of ice of an unknown thickness. The summit level of this ice-sheet in the neighbourhood of the South Pole is about 10,000 feet, but other parts of it may be even higher. It is believed that the ice-sheet in the interior is at least 2000 feet thick, but thinner toward the edges of the continent. At the height of the great Ice Age this ice-sheet was probably a great deal thicker than at present.

Nearly all the rock features of the continent are submerged in ice, but a few great mountain ranges stand above it, and here and there a few isolated peaks, called nunataks. The chief range is a great horst or fault range in South Victoria Land, south of Australia, which is known in different parts as Prince Albert Range, Royal Society's Range, Commonwealth Range, and Queen Maud Range, the names indicating the period and nationality of its discoverers. These ranges rise to heights of 13,000 to 15,000 feet, which is 2000 to 9000 feet above the ice-sheet. The greater part of the continent appears to be a plateau of Archæan and Primary rocks, from which these ranges were faulted upward.

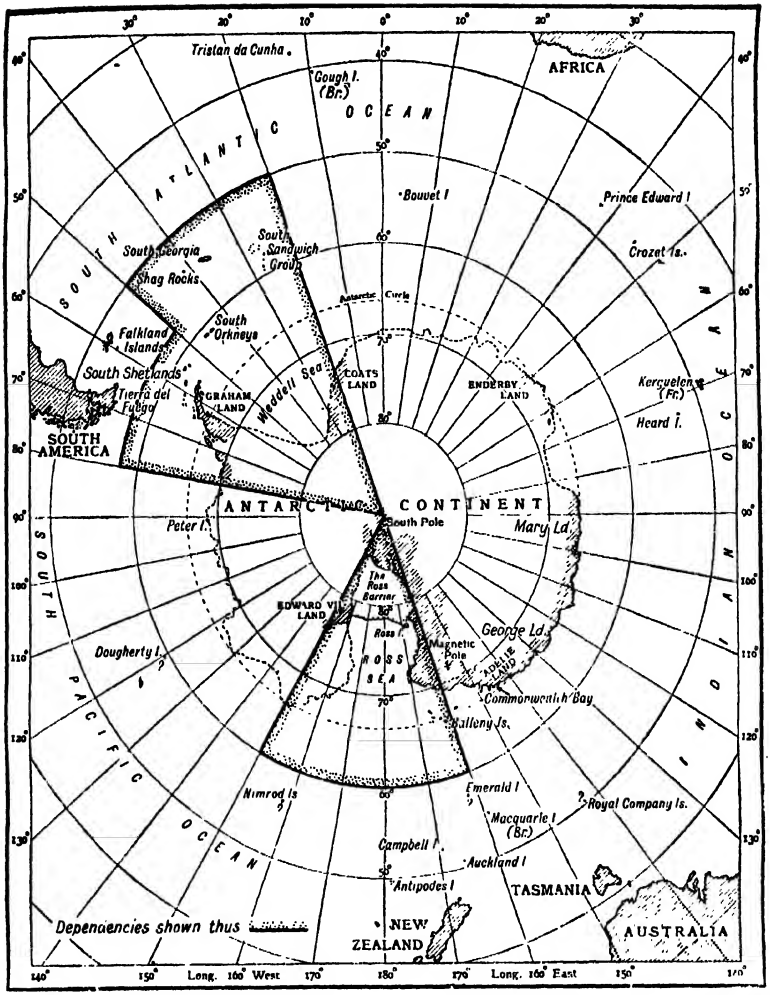

FIG. 165. THE CONTINENT OF ANTARCTICA AND THE BRITISH DEPENDENCIES

Recent exploration has slightly modified the outline of the continent. Graham Land is now known to consist of two large islands. New stretches of coast have been discovered to the north-east of Coats Land and to the west of Enderby Land.

From "Discovery," by permission of Messrs Benn Bros., Ltd.

On the Pacific side of the continent there lie continuations of the fold and fault ranges of South America. These are largely submerged beneath the sea, and show as island groups, which have been explored only south of South America, in the region known as Graham Land, or West Antarctica.

Climate

The climate of the Antarctic is severe all the year round. No month has a mean temperature above freezing-point. In the coldest month the mean temperature at sea-level falls to − 14° F. or as low as - 48° F. Even on islands at some distance from the continent the winter mean is well below freezing-point and the summer mean not above 32°. Precipitation is about 8 to 12 inches in the year, and falls entirely as snow. Winds are generally from the south or south-east, and frequently blow with great strength, driving snow before them and so causing blizzards.

In this climate the snowline is at sea-level, so that very little land is free from snow even in the height of summer. Only a few beaches, cliffs, and rocky slopes are bare. Soil is very scanty, and the lack of summer warmth almost prevents plant growth. There is no possibility of the cultivation of any crop.

Ice

The ice-sheet overflows the shore in many places, and floats out to sea in glacier tongues. Some of these persist for years. In other places the ice calves off into gigantic flat-topped icebergs, which may be a mile in length or even as much as fifty to eighty miles. Icebergs of this size and shape are found only in South Polar seas, though at times they drift into the Southern Ocean and imperil shipping between New Zealand and Cape Horn or between South Africa and New Zealand. For this reason vessels never follow the shortest Great Circle routes on such courses.

Around the edge of the continent the sea freezes in the winter, and even at times in the cold summer. Thus floes are formed. In large numbers these form pack-ice. The

pack-ice drifts to and fro with wind and current, but never melts unless it is blown to the warmer waters of the Southern Ocean. It is this ice that frequently bars the way to exploring ships, and, habitually collecting in certain seas, prevents access to the coast of the continent.

A peculiar formation of ice is that known as the Ross Ice Shelf, or Great Ice Barrier, at the head of the Ross Sea. It appears that this vast expanse of ice, covering a larger area than the British Isles, was built of glacier tongues from the

FIG. 166. ICE-FLOES OF THE ANTARCTIC

The ship is caught in the drifting pack-ice. In the distance there can be seen a tabular iceberg from the ice-sheet covering the continent.

Photo R. N. Rudmose Brown

plateau projecting into and floating on the sea, where they coalesced and were subsequently buried in snow, thus acquiring a level surface.

PLANT AND ANIMAL LIFE

The lack of soil, the presence of snow and ice, and the low summer temperatures check plant growth. There are many mosses and lichens and an abundance of seaweeds, but vegetation never covers the ground continuously. Only two flowering plants have been recorded from the Antarctic, a grass and another herbaceous plant. Both are rare and always stunted, and are found only in the islands south of

South America, which experience a more open climate than other parts.

There is no plant or animal life on the ice-sheet, which is thus a complete desert. The sterility of the land bars the existence of any land animals except a few lowly insects, etc. But the seas teem with life. This is ultimately dependent on the abundance of plant life in South as in North Polar seas. Many kinds of sea-birds come to the Antarctic to nest in summer. These include various kinds of petrels, gulls, and particularly penguins. In summer almost every snow-free site around the shores of the continent and on adjacent islands is occupied by a penguin rookery. Nowhere else in the world do so many birds of any kind congregate in masses as in the penguin rookeries in the Antarctic. One kind, the large Emperor penguin, never leaves the Antarctic, and lays its eggs in mid-winter.

There are also many seals in the Antarctic seas, but nearly all are hair and not fur seals, and so are of little commercial value. Whales are numerous beyond the floating ice, but are being reduced in numbers rapidly by too much hunting.

Economic Development

Even if minerals of value were discovered it does not seem probable that they could be mined owing to climatic difficulties interfering with labour and transport.

Whaling is pursued actively in some Antarctic seas, particularly around the islands of South Georgia, the South Orkneys, and South Shetlands, in the Atlantic part of the Southern Ocean, and in the Ross Sea, south of New Zealand. In some parts—*e.g.*, South Georgia and the South Shetlands (Deception Island)—the whales when killed are towed to shore stations to be boiled down for oil. In the Ross Sea floating factories—that is, large vessels—receive the whales and take the place of shore stations. In 1928–29 the total Antarctic production of whale oil was about 1,600,000 barrels, valued at about £8,000,000. A whale yields an average of 70 barrels. Most of the whaling is pursued by Norwegians, but there are a few British companies.

ANTARCTICA

Political Interests

Whaling has brought the Antarctic within the area of political claims. The dependencies of the Falkland Islands constitute a British claim between the meridians of 20° and 80° W. south of latitude 50° S., except the area included by the parallels of latitude 50° S. and 58° S. and the meridians of 50° W. and 80° W. The second British claim is the Ross Dependency of New Zealand, which includes the area between the meridians of 160° E. and 150° W. south of latitude 60° S. A further British claim has recently been made on the east of Enderby Land. Norwegian claims have been made to the west of Enderby Land and in the two islands of Bouvet and Peter I. The French have long maintained a claim to the island of Kerguelen. No permanent administrators live in any of these Antarctic possessions, and at the most there is only a summer population of whalers.

STATISTICAL APPENDIX

The trade statistics are for the year 1928 except in the case of New Zealand, for which the figures are for 1929.

Political Division	Area in Square Miles	Population	Imports in Thousands of £	Exports in Thousands of £	Capital or Administrative Centre
(A) *COMMONWEALTH OF AUSTRALIA*	2,974,581	6,429,207	147,945	143,213	Canberra
New South Wales	309,432	2,483,645	65,081	51,823	Sydney
Victoria	87,884	1,783,649	47,911	31,729	Melbourne
Queensland	670,500	934,643	11,760	21,855	Brisbane
South Australia	380,070	580,242	12,509	18,030	Adelaide
Western Australia	975,920	417,423	9,011	16,252	Perth
Tasmania	26,215	215,900	1,641	3,434	Hobart
North Australia	523,620	4,584	30	29	Newcastle Waters
Central Australia					Alice Springs
Federal Territory	940	9,045	-	-	Canberra
Norfolk Island	13	900	43	20	—
Territory of Papua	90,540	276,500	404	350	Port Moresby
Mandated Territories					
North-east New Guinea	68,500	240,000			
Bismarck Archipelago	18,000	135,000	812	1,470	Rabaul
Solomon Islands	3,800	56,000			
(B) *DOMINION OF NEW ZEALAND*	103,285	1,488,595	48,797	54,176	Wellington
North Island	44,131				—
South Island	58,120				—
Stewart Island	662				—
Chatham Islands	372				—

Political Division	Area in Square Miles	Population	Imports in Thousands of £	Exports in Thousands of £	Capital or Administrative Centre
Tokelau or Union Group	4	1,000	—	—	—
Cook Group and Niue	280	14,300	136	154	Rarotonga
Mandated Territory					
Western Samoa	1,440	44,000	327	422	Apia
(C) *BRITISH ISLAND GROUPS*					
Solomon Islands	11,000	150,000	300	430	Tulagi
Fiji	7,083	176,793	1,483	2,701	Suva
Gilbert & Ellice Islands	180	30,000	150	313	Ocean Island
Tonga Islands	390	27,000	212	290	Nukualofa
Combined Mandate					
Nauru	8	2,614	240	320	—
(D) *ANGLO-FRENCH CONDOMINIUM*					
New Hebrides	5,700	51,000	375	400	Vila
(E) *FRENCH GROUPS*					
New Caledonia and the Loyalty Islands	8,548	52,000	1,250	800	Noumea
French Establishments in Oceania	1,520	36,000	400	350	Papeete
(F) *UNITED STATES TERRITORY*					
Eastern Samoa	60	8,800	50[1]	18[1]	Pago Pago

[1] Figure for 1926.

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